Military & Aerospace Electronics
MARCH 2010 · VOL. 21 NO. 3
THE MAGAZINE OF TRANSFORMATION IN ELECTRONIC AND OPTICAL TECHNOLOGY

DOD Budget
The DOD budget is out, and it looks good. **PAGE 4**

Embedded Computing
Mainstream, COTS technologies combine with aerospace and defense industry innovations to deliver increased performance in compact electronics designs. **PAGE 22**

Major shipboard electronics breakthroughs

Open-architecture and COTS technologies advance electronics aboard Navy ships. Page 15

WWW.MILAERO.COM

POWER BY DESIGN

Custom power solutions designed to fit your specific needs

Vicor Custom Power: Small company responsiveness, large company resources

The sole focus of Vicor Custom Power is designing and manufacturing turnkey custom power systems that meet your specific needs. Vicor Custom Power maintains the flexibility of a small entrepreneurial company while taking advantage of Vicors technical and business resources to deal effectively with your most challenging power requirements. Vicor has invested in the tools and resources to offer you full service solutions from prototype to mass production with the shortest lead times and the lowest risk.

General Capabilities:

- Electrical and Mechanical Design
- Rapid Prototyping
- High Volume Production Capacity
- MIL-STDs Compliance
- Reliability / Certification Testing:

High Temperature Operational Life	Altitude
HALT *(Highly Accelerated Life Test)*	Explosive Atmosphere
Mechanical / Thermal Shock	Temperature Cycling
Vibration	Burn In
Humidity	EMI
Acceleration	Transient Immunity

VICOR • MADE IN THE USA

Put Vicor Custom Power to work for you today, call 1-800-496-5570 to speak with a Vicor Custom Power engineer, or email apps@vicorcustom.com

vicorcustom.com

VICOR CUSTOM POWER

MARCH 2009 • VOLUME 21, NUMBER 3

CONTENTS

4 TRENDS

6 NEWS

6 IN BRIEF

14 SPECIAL REPORT
Navy on the verge of major shipboard electronics breakthroughs
Open-architecture and commercial technologies are critical for advances in ship propulsion, navigation and guidance, weapons control, ballistic missile defense, modular mission packages, and related systems for the nation's maritime defense.

22 TECHNOLOGY FOCUS
Empowering embedded computing
Mainstream, COTS technologies combine with aerospace and defense industry innovations to deliver increased performance in compact electronics designs.

32 OPINION

34 PRODUCT INTELLIGENCE
Multisensor designs and increasing resolutions are major trends in infrared and other electro-optical sensors.

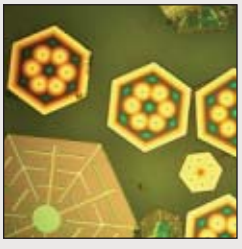
36 ELECTRO-OPTICS WATCH

39 PRODUCT APPLICATIONS

42 CORE i7 PRODUCTS

44 NEW PRODUCTS

48 MILAERO.COM



ON THE COVER

Advanced shipboard electronics are integral to the effectiveness of the U.S. Navy and to the success of its missions. Industry leaders step up to the challenge, and Navy ships gain much-needed electronics modifications, with the implementation of novel commercial off-the-shelf and open-architecture technologies. **Page 14**

TRENDS

The DOD budget is out, and the news is good

By **JOHN KELLER**
EDITOR IN CHIEF

The Obama Administration's military budget proposals for next year are out, and we can breathe a collective sigh of relief.

The aerospace and defense industry has spent months fretting about President Obama's 2011 defense budget—more out of uncertainty than fear. It is this proposed budget, far more than the one last year, that gives us our first clear indication of how the Administration plans to treat defense spending, and the verdict is, better than we thought. The 2010 budget request for the U.S. Department of Defense (DOD) essentially was George W. Bush's last defense budget. It wasn't until the 2011 budget proposal was released that we saw how Obama wants to proceed with military spending. The numbers speak for themselves.

The overall DOD budget is $708 billion, which consists of $549 billion in the discretionary defense budget, and $159 billion to support continuing military operations in Iraq and Afghanistan. The discretionary DOD budget of $549 billion—which includes proposals for military personnel, military construction, and family housing, in addition to military procurement, research and development, and operations and maintenance—is an increase of $18 billion over the $531 billion enacted for 2010. This is an increase of 3.4 percent, or 1.8 percent real growth after adjusting for inflation.

Those top-line budget numbers, fail to convey the real story for the aerospace and defense electronics industry. To do this requires us to look closely at DOD budget for procurement, as well as the budget for research, development, test, and evaluation (RDT&E), because these budgets largely deal with current and future military technologies. The 2011 DOD procurement budget asks Congress for $137.48 billion, which is up only slightly—1.05 percent—from current-year procurement spending of $136.06 billion, yet the trend is clearly going in the right direction—particularly in light of concerns that the Obama Administration was looking to cut defense spending.

RDT&E is another story. The proposed military research budget for next year is $76.77 billion, which is down 5.13 percent from current-year spending of $80.92 billion, but was not as drastic a cut as it could be.

Now look at the combined procurement and RDT&E budget lines for military communications, electronics, telecommunications, and intelligence (CET&I) technologies. Next year's CET&I proposed budget is for $17.45 billion, which is an increase of 3.2 percent from this year's CET&I congressionally enacted spending levels of $17.45 billion.

This is good news for the military electronics and electro-optics industries. We can be on solid ground as we plan for the future. Barring unforeseen circumstances, we aren't going to see substantial defense spending cuts over the next several years. President Obama's agenda seems to revolve around domestic programs; for defense spending, it's steady as she goes—at least for now.

Now we're into an election year, and no one in the Administration or on Capitol Hill wants to rock the boat on defense spending and preparedness as we move closer to the congressional mid-term elections next November. Barring unforeseen circumstances, we are not likely to see substantial increases in defense spending over the next several years, yet we are not likely to see major cuts, either. I don't see any end in sight in the "overseas contingency operations." We'll see a continuing solid market for advanced sensors, battlefield networking, optics and fire control, and new technologies that will be involved in counter-terror and counter-insurgency operations.

Everyone involved in the military technology business can get to sleep tonight, resting assured, that the Department of Defense is still open for business.

MILITARY & AEROSPACE ELECTRONICS ©2010 (ISSN-1046-9079) is published monthly by PennWell Corp.,1421 S. Sheridan, Tulsa, OK 74112. Periodicals postage paid at Tulsa, OK 74101 and additional mailing offices. Editorial offices are located at 98 Spit Brook Road, Nashua, NH 03062-5737. Subscription Prices: Free to qualified subscribers in North America. Other subscribers in U.S.A $160.00 one year, $280.00 two years, $410.00 three years. Other subscribers in Canada $250.00 one year, $430.00 two years, $580.00 three years. All other International $330.00 one year, $575.00 two years, $750.00 three years. Call (847) 559-7500 for subscription information. We make portions of our subscriber list available to carefully screened companies that offer products and services that may be important for your work. If you do not want to receive those offers and/or information, please let us know by contacting us at List Services, Military & Aerospace Electronics, 98 Spit Brook Road, Nashua, NH 03062. **POSTMASTER:** Send change of address form to MILITARY & AEROSPACE ELECTRONICS, PO Box 3295, Northbrook, IL 60065-3295. Back issues of Military & Aerospace electronics may be purchased at a cost of $15.00 each in the U.S., $20.00 Canada, and $25.00 elsewhere. **RETURN UNDELIVERABLE CANADIAN ADDRESSES TO:** P.O. Box 122, Niagara Falls, ON L2E 6S4. **Printed in the USA / GST NO. 126813153 / Publications Mail Agreement No. 875376**

Military & Aerospace Electronics

SENIOR VICE PRESIDENT, GROUP PUBLISHER
CHRISTINE SHAW
TEL (603) 891-9178 • cshaw@pennwell.com

ASSOCIATE PUBLISHER
DOUGLAS M. MAILAT
TEL (603) 891-9137 • dougm@pennwell.com

EDITOR-IN-CHIEF JOHN KELLER
TEL (603) 891-9117 • FAX (603) 891-9146
jkeller@pennwell.com

EXECUTIVE EDITOR JOHN McHALE
TEL (603) 891-9119 • FAX (603) 891-9146
jmchale@pennwell.com

SENIOR EDITOR COURTNEY E. HOWARD
TEL/FAX (509) 587-3344 • courtney@pennwell.com

CONTRIBUTING EDITOR
WESTERN BUREAU J. R. WILSON
TEL (702) 434-3903 • FAX (702) 920-8068
jrwilson@pennwell.com

ART DIRECTOR KELLI MYLCHREEST

PRODUCTION DIRECTOR MARI RODRIGUEZ

SENIOR ILLUSTRATOR CHRIS HIPP

AUDIENCE DEVELOPMENT MANAGER
JAYNE SEARS-RENFER
TEL (603) 891-9416 • jaynesr@pennwell.com

AD SERVICES MANAGER MELANIE LEMONS
TEL (918) 831-9484 • admaterial@pennwell.com

PennWell

EDITORIAL OFFICES
PENNWELL CORPORATION,
MILITARY & AEROSPACE ELECTRONICS
98 Spit Brook Road LL-1, Nashua, NH 03062-5737
TEL (603) 891-0123 • Fax: (603) 891-0514 • www.milaero.com

SALES OFFICES
REPRINTS ANTOINETTE HIGH
TEL (717) 505-9701 • Antoinette.high@theygsgroup.com

LIST RENTAL BOB DROMGOOLE
TEL (603) 891-9128 • FAX (603) 891-9341
bobd@pennwell.com

EAST OF MISSISSIPPI PHIL DAVIS, SALES MANAGER
PennWell Publishing 106 Kenton Court, Simpsonville, SC 29681
TEL (864) 288-2290 • Cell (630) 248-5525
FAX (864) 284-9934 • phild@pennwell.com

WEST OF MISSISSIPPI JAY MENDELSON
4957 Chiles Drive, San Jose, CA 95136
TEL (408) 221-2828 • FAX (650) 941-5120
jaym@pennwell.com

MILITARY & AEROSPACE ELECTRONICS SHOW CONFERENCE & EXHIBITION GROUP
MARKETING MANAGER JENNIFER MAcPHAIL
TEL (918) 831-9701 • jenniferm@pennwell.com

GROUP EXHIBITS SALES MANAGER JO-ANN PELLEGRINI
TEL: 650-941-3438, ext 26 • joannp@pennwell.com

CORPORATE OFFICERS
CHAIRMAN FRANK T. LAUINGER

PRESIDENT AND CEO ROBERT F. BIOLCHINI

CHIEF FINANCIAL OFFICER MARK WILMOTH

TECHNOLOGY GROUP
SENIOR VICE PRESIDENT/PUBLISHING DIRECTOR
CHRISTINE SHAW

SENIOR VICE PRESIDENT AUDIENCE DEVELOPMENT
GLORIA S. ADAMS

SUBSCRIPTION INQUIRIES
TEL (847) 559-7500 • FAX (847) 291-4816
e-mail: mae@omeda.com, web: mae-subscribe.com

BPA WORLDWIDE

AMERICAN BUSINESS MEDIA
The Association of Business Media Companies

EXTRAORDINARY WEAPON SIGHTS. YOU CAN SEE THE DIFFERENCE A MILE AWAY.

FLIR Systems, the leading innovator of EO/IR technology, goes the distance for global special operations forces across the spectrum of missions with our ThermoSight™ advanced weapon sights. From surveillance and recon to target acquisition and force protection, we meet unique SOF operational requirements for durability, crisp imagery, ultra-long range capabilities, minimal weight and up to seven hours of battery life. To share our extraordinary vision go directly to the source. www.FLIR.com/GS

FLIR Extraordinary Vision

NEWS

Marine aviators complete operational assessment of advanced Precision Kill Weapon System

By **COURTNEY HOWARD**

CHINA LAKE NAVAL WEAPONS CENTER, Calif.—U.S. Marine Corps aviators have completed their operational assessment of the BAE Systems Advanced Precision Kill Weapon System (APKWS), which scored eight direct hits in eight shots in January and February. The operational assessment provides Marine aviators the opportunity to "test drive" the system before it is deployed, and to confirm that the laser-guided, 2.75-inch rocket will meet their needs in combat.

APKWS, developed by BAE Systems in partnership with the U.S. government, is intended to provide aviators with a precise weapon against soft and lightly armored targets while minimizing collateral damage. APKWS will prove useful in urban areas and situations in which non-combatants or friendly forces are near hostile targets.

Marine AH-1W Cobra attack helicopters fired laser-guided APKWS rockets with live warheads to hit targets in January while flying a variety of scenarios. "The APKWS operational assessment has demonstrated the system's effectiveness in a variety of scenarios involving various targets, platform speeds, ranges, and tactics," says Maj. Matt Sale, requirements officer

The Marine Corps. AH-1W Cobra attack helicopter, shown above, used the Advanced Precision Kill Weapon System in recent tests.

Continued on page 10

Air Force to use artificial intelligence and other advanced data processing to hit the enemy where it hurts

By **JOHN KELLER**

ROME, N.Y.—U.S. Air Force researchers are asking for industry's help to develop advanced intelligence-collection and rapid-response capability to help U.S. forces attack enemies quickly at their most vulnerable and damaging points.

The idea is to collect, analyze, and take action in real time on intelligence information collected from many different sources to carry out so-called "effects-based operations" to do the most damage to the enemy as quickly as possible.

Air Force researchers are emphasizing machine-to-machine intelligence communications and cooperation in this project, which will rely on technologies like artificial intelligence, ontological reasoning, and knowledge-based processing.

For the Air Force, effects-based operations seeks to enable one aircraft to attack several different high-value targets quickly to inflict maximum damage to the enemy, while keeping collateral damage to a minimum.

This broad agency announcement (BAA-10-07-RIKA), called Synchronized Net-Enabled Multi-INT Exploitation, was issued in late January from the Air Force Research Laboratory Information Directorate in Rome, N.Y., and aims at innovative, disruptive technologies for cueing and collection of intelligence automatically for situational awareness, assessment, and military action.

For this project, Air Force researchers seek to automate the collection and use of intelligence information gathered from many different platforms and correlated in

Continued on page 10

IN BRIEF

Team K-MAX demonstrates unmanned helicopter cargo re-supply to U.S. Marine Corps

Lockheed Martin Corp. and Kaman Aerospace Corp., a subsidiary of Kaman Corp., demonstrated to the U.S. Marine Corps the capability of the unmanned K-MAX helicopter to resupply troops by unmanned helicopter at forward operating bases in Afghanistan. During flights in subfreezing temperatures at the U.S. Army's Dugway Proving Ground, Utah, in February, the unmanned K-MAX demonstrated autonomous and remote control flight over line-of-sight and satellite-based beyond line-of-sight data link. "We met or exceeded the requirements within the scheduled three-day timeframe of the demonstration," says Dan Spoor, aviation systems vice president at Lockheed Martin's Mission Systems & Sensors facility in Owego, N.Y. "The system performed a rigorous set of cargo re-supply scenarios as programmed, allowing the ground-based operator to monitor progress, and make adjustments to aircraft positioning only when requested by the Marine Corps for demonstration purposes." Performance attributes demonstrated included: hovering at 12,000 feet with a 1,500-pound sling load, delivering 3,000 pounds of cargo within the six-hour required timeframe to a forward operating base, remotely controlling flight and a precision load delivery by a ground-based operator in both day and night conditions, and uploading a new mission plan to the aircraft's mission management system during flight.

Rockwell Collins advances next-generation GPS by tracking new military signal

Rockwell Collins in Cedar Rapids, Iowa, achieved live satellite M Code tracking with its latest Global Position System (GPS) receiver for the modernized user equipment (MUE) program. The MUE receiver card development program, awarded to Rockwell Collins by the U.S. Air Force Space and Missile Systems Center (SMC), is developing the military user equipment portion of the next-generation GPS system that incorporates a new military signal and security architecture. The technology offers enhanced integrity, exclusivity, and improved anti-jam capabilities. M Code, which stands for Military Code, is a key element in the modernization of military GPS. While it is transmitted on the same L1 and L2 frequencies used by the legacy P(Y) Code, it will improve the security of military GPS.

DOD proposes 3.2 percent spending increase on electronics and communications in 2011 budget set to reach $17.45 billion

By **JOHN KELLER**

WASHINGTON—Leaders of the U.S. Department of Defense (DOD) propose spending $17.45 billion in fiscal year 2011 for procurement and research in military communications, electronics, telecommunications, and intelligence (CET&I) technologies, which would represent an increase of 3.2 percent from current-year enacted levels of $16.9 billion, according to Pentagon budget documents.

This amount in the 2011 DOD budget does not include military activities with substantial electronics content, such as aircraft avionics, vetronics, and missile guidance; when these are added, DOD spending levels for electronics and electro-optics could approach $106.2 billion, industry analysts believe.

Experts estimate that total DOD electronics, electro-optics, and information technology spending is roughly 15 percent of the total DOD budget. Most of the DOD's technology spending is in the procurement, research, and development accounts.

The DOD's CET&I budget request for next year consists of $11.65 billion in CET&I procurement—up 3.86 percent from current-year levels of $11.22 billion—and $5.8 billion in CET&I research and development—up 2 percent from current-year levels of $5.68 billion.

The U.S. Army in 2011 is asking for $7.96 billion in CET&I procurement and research—0.46 percent from current-year levels of $7.93 billion. The Army's CET&I request consists of $6.73 billion in communications and electronics procurement, and $772.49 million in communications and intelligence research and development.

The U.S. Navy and Marine Corps in 2011 are asking for $3.29 billion CET&I procurement and research—up 2.23 percent from current-year levels of $3.22 billion. This request consists of $1.96 billion for Navy and Marine Corps communications and electronics procurement, and $1.33 billion in combined Navy/Marine Corps communications and intelligence research.

The U.S. Air Force in 2011 is asking for $5.37 billion for CET&I procurement and research—up 9 percent from current-year levels of $4.92 billion. The Air Force CET&I request consists of $2.39 billion for communications and telecommunications procurement, and $2.98 billion for intelligence and communications research and development.

Service-independent Pentagon agencies are asking for $823.85 million in CET&I procurement and research in 2011—down 3.91 percent from current-year levels of $857.41 million. This request consists of $67.81 million in communications and electronics procurement, and $756 million in intelligence and communications research and development.

In total for 2011, which begins next Oct. 1, DOD leaders are asking Congress for $708 billion—$549 billion in discretionary spending, and $159 billion to support the continuing wars in Iraq and Afghanistan—which the Obama Administration calls "overseas contingency operations."

The DOD's proposed $549 billion discretionary budget includes spending proposals for military personnel, military construction, and family housing. This $549 billion base DOD budget is about 3.3 percent larger, or an increase of $18 billion, than the 2010 base DOD budget, according to Pentagon documents.

For procurement in 2010, DOD is asking Congress for $137.48 billion, which is up 1.05 percent from current-year procurement spending of $136.06 billion. For research and development, DOD proposes to spend $76.77 billion in 2011, which is down 5.13 percent from current-year spending of $80.92 billion. It now is up to Congress to authorize or reject the military's spending proposals.

IN BRIEF

Sonoscan expands counterfeit identification menu

SonoLab, the applications laboratory division of Sonoscan in Elk Grove Village, Ill., developed analytical techniques that bring to 25 the number of acoustically detectable features and characteristics used to separate counterfeit plastic IC packages from genuine packages. "The increase in useful tools is the result of our growing base of experience in separating counterfeit components from genuine parts—often within a mixed lot shipment," says SonoLab manager Ray Thomas. "Our laboratories are seeing more questionable parts because the industry has become much more interested in weeding out counterfeit parts. Ideally, engineers have known genuine parts to which they can compare incoming parts." Using a greater number of acoustic techniques increases the confidence factor when separating genuine parts from fake parts, Sonoscan officials say. Measuring two or three parameters may suggest that a part is genuine or fake, but having a menu of 25 items on hand makes it easier to make clear distinctions. "Acoustic imaging is especially convincing because it has the flexibility to go after hard-to-imitate features and material characteristics, such as acoustic impedance, filler particle distribution and bond integrity," Thomas says.

Boeing connects first F-22 mission training center to Air Force network

Boeing in St. Louis connected the F-22 mission training center (MTC) at Langley Air Force Base, Va., to the U.S. Air Force's distributed mission operations network (DMON), enabling F-22 pilots at the base to train virtually with pilots flying aircraft for the first time. The MTC at Langley is the first of four F-22 training centers that Boeing will link to the network over the next three years. The Air Force's distributed mission operations (DMO) configuration enables MTC sites to connect with one another via the DMON, increasing the scale and improving the accuracy of training operations. Connecting the four-seat F-22 MTC flight trainer to the DMON also provides F-22 pilots with more realistic training with other Air Force assets on the network, such as the F-15C MTC. This MTC was also the first to use the Agile Software Development process, which is based on industry and Boeing best practices for efficient software development. This process allowed the functionality of the trainer's components to be assessed much faster than with traditional software-development methods. Boeing is on contract to deliver three new F-22 MTCs for Elmendorf Air Force Base, Alaska; Holloman Air Force Base, N.M.; and Hickam Air Force Base, Hawaii.

Northrop Grumman's Scalable Agile Beam Radar demonstrated on F-16

Northrop Grumman Corp. in Linthicum, Md., worked with the U.S. Air Force on demonstration flights of its Scalable Agile Beam Radar (SABR) installed in an F-16 jet fighter aircraft at Edwards Air Force Base, Calif. The flights demonstrated an F-16 active electronically scanned array (AESA) radar study. Compared to mechanically scanned array radars, SABR will provide the increased performance, multifunctionality, and reliability of AESA radars. SABR provides improved situational awareness, greater detection, high-resolution synthetic aperture radar (SAR) maps, interleaved air-to-air and air-to-surface mode operations, and an all-environment precision strike capability. "This demonstration validated our goal of developing an AESA that can be easily installed on the flight line and integrated with existing power and cooling provisions of currently fielded F-16s," says Arlene Camp, director of Advanced F-16 Radar Programs at Northrop Grumman's Electronic Systems sector.

U.S. Air Force selects ODIN to monitor and maintain RFID network

The U.S. Air Force Global Logistics Support Center selected ODIN in Dayton, Ohio, to monitor and maintain its network of passive RFID readers deployed in the continental U.S., Alaska, and Hawaii. The contract scope covers seven Air Force bases, one Navy base, and nearly 150 passive RFID (radio-frequency identification) readers. ODIN will be responsible for updating firmware, determining proper configuration, and keeping performance optimized. The contract, including two option years, extends until January 2013. The Air Force is using RFID to improve business processes ranging from tracking hazardous material to receiving goods from suppliers. The Air Force bases and Navy base covered under the contract with RFID networks installed include: Charleston AFB,

UAV avionics covered at Avionics Europe conference

AMSTERDAM, The Netherlands—Avionics for unmanned aerial vehicles (UAVs) will be discussed at the 2010 Avionics Europe conference and exhibition March 24 to 25 at the Air Passenger Terminal in Amsterdam, The Netherlands.

The Unmanned Systems Avionics session speakers include David Voss, senior director of unmanned aircraft at Rockwell Collins and Craig Hoover of GE Aviation Systems. The session is chaired by Alex Wilson, senior program manager, aerospace and defense at Wind River Systems.

Other key speakers include Didier Delibes, Airbus ATM engineering senior manager; Steve Duenkel, senior program manager, Boeing Commercial Aviation Services; and Simo Tauriainen, avionics system manager, Finnish Commuter Airlines.

The conference Web site is www.avionics-event.com. For more on the conference agenda, visit http://www.avionics-event.com/index/conference-information.html.

For International exhibit sales, contact Gareth Watkins at +44 (0) 1992 656 672 or garethw@pennwell.com. For North America exhibit sales, contact Jo-Ann Pellegrini at 650-941-3438 or JoAnnP@pennwell.com.

Air Force from page 6

several different ways, make better use of raw sensor data from existing multisource, multiplatform, real-time collection systems, and automate intelligence information processing for assessment, cueing, electronic attack, and battle damage assessment.

The intent is to address increasing volumes of data quickly enough to take advantage of enemy vulnerabilities before the enemy can take corrective action.

The focus of this program is to characterize and correlate data sources on existing multisource, multiplatform, real-time collection systems, use multi-platform collection for dynamic exploitation, automatically cue sensors and recommend opportunities, and automatically exploit intelligence information.

The project will involve issues, such as target-specific characteristics for identification and correlation; automated data collection, signals identification, and intelligence processing; enabling architectures for advanced intelligence exploitation; application-specific software; advanced knowledge-based processing; network-centric collection, information exchange, and correlation; technologies to capitalize on motion imagery; technologies for human intelligence gathering; and advanced digital signal processing.

Funding for the project will be roughly $24.5 million through 2012. Those interested should submit white paper concept descriptions by 1 Nov. 2010 for 2011 projects; and by 1 Nov. 2011 for 2012 projects. White papers will be accepted until 28 Sept. 2012.

Send white papers by registered mail post to AFRL/RIEG, 525 Brooks Road, Rome, N.Y. 13441-4505, and refer to BAA 10-07-RIKA.

For questions or concerns, contact the Air Force's Dan Stevens by phone at 315-330-2416, or by e-mail at daniel.stevens@rl.af.mil.

More information is online at https://www.fbo.gov/spg/USAF/AFMC/AFRLRRS/BAA-10-07-RIKA/listing.html.

Marine from page 6

for Marine Corps Aviation Weapons.

"The system's reliability has been proven with its 19-for-19 performance in tests, exceeding requirements and expectations," Sale continues. "We are confident that APKWS is the right-size weapon for many of our typical engagements and will be highly effective in allowing Marine aviators to prosecute targets."

The final step in APKWS development is to qualify the system for conditions in which it might be employed, transported, and stored. The Navy (parent service of the Marine Corps) may enter low-rate initial production within the next two or three months.

"Any time I have the opportunity to talk to our men and women in uniform, I hear about the pressing need for the capability afforded by APKWS," says John Watkins, director of missiles and munitions for BAE Systems in Nashua, N.H. "This weapon will make a real difference in allowing U.S. warfighters to complete their missions and come home safely."

IN BRIEF

S.C.; Dover AFB, Del.; McChord AFB, Wash.; McGuire AFB, N.J.; Norfolk NAT, Va.; Travis AFB, Calif.; Elmendorf AFB, Ark.; and Hickam AFB, Hawaii.

Lockheed Martin begins C-5 Galaxy avionics upgrade

Lockheed Martin Corp. inducted its second C-5 Galaxy strategic transport into the Reliability Enhancement and Re-engining Program (RERP) production line at its Marietta, Ga., facility to upgrade its avionics and other flight systems. The RERP modifications consist of more than 70 improvements and upgrades to the C-5 airframe and aircraft systems, and include the installation of new higher-thrust, more reliable turbofan engines. The C-5M is the product of a two-phase modernization effort. The first, the ongoing Avionics Modernization Program (AMP), provides the aircraft a state-of-the-art glass cockpit with modern avionics and flight instruments. RERP is the second phase of the C-5 modernization effort. Current Air Force plans call for Lockheed Martin to deliver 52 C-5Ms (modification of 49 C-5Bs, two C-5Cs, and one C-5A) by 2016. Three C-5Ms have been redelivered to the U.S. Air Force at Dover AFB, Del.

Harris weapon data link receives NSA certification

An advanced data link developed by Harris Corp. in Melbourne, Fla., and ViaSat in San Diego for Boeing's proposed Small Diameter Bomb Increment II (SDB II) program completed risk-reduction tests, receiving Type 1 certification from the National Security Agency (NSA). The SDB II Weapon Data Link (WDL) will connect the munitions to tactical networks, allowing operators to engage moving targets on the ground even after a munition is launched. Harris demonstrated the system using Link-16 and Combat Net Radio UHF transmissions as part of the SDB II risk reduction program. In both Link-16 and UHF modes, the munition's messaging protocol was demonstrated. The Harris Small Secure Network Terminal (SSNT), a network-enabled radio using a software communications architecture (SCA), received National Security Agency (NSA) Type 1 certification. Type 1 certification means the Weapon Data Link is able to communicate secret-level classified information. The Harris Sierra II encryption technology provides the foundation for this level of information security. Harris and ViaSat will provide the dual waveform data link to Boeing for the joint U.S. Air Force and Navy SDB II program.

2011 DOD budget proposes increases in procurement, cuts in research, in overall stable request

By **JOHN KELLER**

WASHINGTON—Leaders of the U.S. Department of Defense (DOD) are asking Congress for $708 billion in federal fiscal year 2011—$549 billion in discretionary spending, and $159 billion to support the continuing wars in Iraq and Afghanistan—which the Obama Administration calls overseas contingency operations.

The 2011 DOD budget proposes $549 billion in discretionary spending that includes proposals for military personnel, military construction, and family housing. This $549 billion base DOD budget is about 3.3 percent larger, or an increase of $18 billion, than the 2010 base DOD budget, and up 6.95 percent from the DOD's 2009 base budget of $513.3 billion, according to Pentagon documents.

The 2011 DOD procurement budget asks Congress for $137.48 billion, which is up 1.05 percent from current-year procurement spending of $136.06 billion. The 2011 DOD research budget proposes spending $76.77 billion, which is down 5.13 percent from current-year spending of $80.92 billion.

In fiscal 2011, which begins Oct. 1, the Pentagon also proposes spending $17.45 billion for procurement and research in military communications, electronics, telecommunications, and intelligence (CET&I) technologies, which would represent an increase of 3.2 percent from current-year enacted levels of $16.9 billion. These procurement and research and development amounts include numbers from the DOD's base budget request, as well as its request for continuing operations in Iraq and Afghanistan.

Air Force spending

The U.S. Air Force would spend the most of any U.S. military service on procurement and research in 2011. The Air Force budget contains $71.66 billion for procurement and research–down 2.77 percent from current-year levels of $73.69 billion. The Air Force budget has $44.14 billion for procurement, up 3.02 percent from the current year, and $27.51 billion for research and development—down 2.33 percent from 2010.

Highlights of the Air Force's technology procurement request include $3.93 billion for 23 F-35 joint strike fighter aircraft; $649.63 million for four RQ-4 Global Hawk unmanned aerial vehicles (UAVs); $576.06 million for modifications to the C-17 cargo jet; $517.6 million to buy one Wideband Gapfiller satellite; $700.7 million to buy one Space Based Infrared Satellite (SBIRS) High; and $216.38 million for communications security equipment. The Air Force budget also would end the C-17 airlifter program at 223 aircraft, and scrap plans to build an alternative engine for the F-35 joint strike fighter.

Highlights of the Air Force's technology research-and-development request includes $198.96 million for developing a next-generation bomber aircraft; $351.82 million for advanced EHF military satellite communications; $426.53 million for space situational awareness systems; $883.78 million for F-35 joint strike fighter research; $863.76 million for next-generation aerial refueling aircraft research; and $828.17 million for Global Positioning System III satellite navigation.

Navy spending

The U.S. Navy and Marine Corps budget contains $67.3 billion for procurement and research—up 1.45 percent from current-year levels of $66.34 billion. The Navy budget has $49.54 billion for procurement, up 6.86 percent from the current year, and $17.75 billion for research and development, down 11.11 percent from 2009.

Highlights of the Navy and Marine Corps procurement request include $1.03 billion to buy 12 E/A-18G electronic warfare jets and $1.78 billion for 22 F/A-18 E/F fighter-bomber aircraft; $2.12 billion for 30 V-22 Osprey tiltrotor aircraft; $3.96 billion for 20 F-35 joint strike fighter aircraft—seven for aircraft carrier operations and 13 short-takeoff and vertical-landing versions; $3.44 billion two Virginia-class fast attack submarines; $2.922 billion for two Arleigh Burke-class guided missile destroyers; and $278.08 million for explosive ordnance disposal systems.

Highlights of the Navy and Marine Corps research-and-development request include $226.29 million for littoral combat ship research; $159.15 million for joint precision-approach and landing systems; $687.72 million for the Joint Tactical Radio System-Navy; $274.37 million for advanced above-water sensors; $549.24 million for DDG-1000 advanced destroyer development; $266.37 million for unmanned combat air vehicle advanced component and prototype development; $245.299 million for Marine Corps communications systems; and $422.27 million for satellite communications. The 2011 Navy budget also would cancel the CG(X) next-generation cruiser and EP(X) Navy intelligence aircraft.

Army spending

After taking the biggest hit in procurement and research in last year's Pentagon budget proposal, the U.S. Army budget request for procurement and research is $44.22 billion, down 0.25 percent from current-year levels. The Army budget contains $33.73 billion for procurement, up 2.87 percent from the current year, and $10.48 billion for research and development, down 9.1 percent from the current-year level of $11.54 billion.

Highlights of the Army's procurement request include $506.31 million to buy 26 MQ-1 Predator UAVs and $37.58 million to buy 312 RQ-11 Raven miniature hand-launched UAVs; $480.25 million to buy 78 Patriot missiles; $299.55 million to buy 83 Stryker armored vehicles; $183 million to upgrade 21 M1 Abrams main battle tanks; $1.43 billion to buy 4,652 family of medium tactical vehicles (FMTV); $429.96 million for the Warfighter Information Network-Tactical (WIN-T); $209.57 million for the Joint Tactical Radio system; $88.24 million for improved HF COTS radio; and $248.9 million for night-vision thermal weapon sights.

Highlights of the Army research-and-development request include $190.9 million for WIN-T; $177.67 million for electronic warfare; $249.95 million for Future Combat Systems unmanned ground vehicles; $251.12 million for Army integrated air and missile defense; $211.5 million for the aerial common sensor; and $123.16 million for the MAQ-1 Sky warrior A UAV.

Defense agencies spending

U.S. defense agencies in 2011 plan to spend $30.88 billion on procurement and research—a 14.54 percent cut from current-year spending levels of $36.14 billion. In 2011, DOD agencies are requesting $10.07 billion on procurement, and $20.82 billion on research and development. Defense agencies include such organizations as the Defense Advanced Research Projects Agency (DARPA), the Special Operations Command (SOCOM), the Office of the Secretary of Defense (OSD),

and the Missile Defense Agency (MDA).

Among the DOD agencies procurement budgets in 2011, the Missile Defense Agency (MDA) is requesting $952.95 million, up 47.83 percent from $644.63 million the MDA received this year. The Defense Information Systems Agency (DISA) is requesting $376.73 million for procurement in 2011, a cut of nearly 7 percent from the $405.02 million that DISA received for procurement this year.

The big money for DOD agencies involves the research-and-development budgets. One of the perennial heavy hitters of defense-wide research programs—the Missile Defense Agency (MDA)—proposes spending $7.45 billion in 2011, up 5.58 percent from $7.06 billion this year. MDA research projects next year include $1.35 billion for ballistic missile defense midcourse defense segment; 1.47 billion for ballistic missile defense technology aboard Aegis navy cruiser and destroyer warships; and $1.11 billion for ballistic missile defense test and targets.

The Defense Advanced Research Projects Agency (DARPA) proposes a research budget next year of $3.1 billion—an increase of 3.75 percent over the $2.99 billion that DARPA received this year. Highlights of DARPA research projects next year include $312.59 million for materials and biological technology; $202.08 million for aerospace systems; $281.26 million for information and communications technology; $219.81 million for command, control, and communications systems; and $205.03 million for sensor technology.

CET&I spending

The DOD's communications, electronics, telecommunications, and intelligence (CET&I) budget request for next year consists of $11.65 billion in CET&T procurement—up 3.86 percent from current-year levels of $11.22 billion—and $5.8 billion in CET&I research and development—up 2 percent from current-year levels of $5.68 billion.

The U.S. Army in 2011 is asking for $7.96 billion in CET&I procurement and research—0.46 percent from current-year levels of $7.93 billion. The Army's CET&I request consists of $6.73 billion in communications and electronics procurement, and $772.49 million in communications and intelligence research and development.

The U.S. Navy and Marine Corps in 2011 are asking for $3.29 billion CET&I procurement and research—up 2.23 percent from current-year levels of $3.22 billion. This request consists of $1.96 billion for Navy and Marine Corps communications and electronics procurement, and $1.33 billion in combined Navy/Marine Corps communications and intelligence research.

The U.S. Air Force in 2011 is asking for $5.37 billion for CET&I procurement and research—up 9 percent from current-year levels of $4.92 billion. The Air Force CET&I request consists of $2.39 billion for communications and telecommunications procurement, and $2.98 billion for intelligence and communications research and development.

Service-independent Pentagon agencies are asking for $823.85 million in CET&I procurement and research in 2011—down 3.91 percent from current-year levels of $857.41 million. This request consists of $67.81 million in communications and electronics procurement, and $756 million in intelligence and communications research and development.

SPECIAL REPORT

Navy on the verge of major shipboard electronics breakthroughs

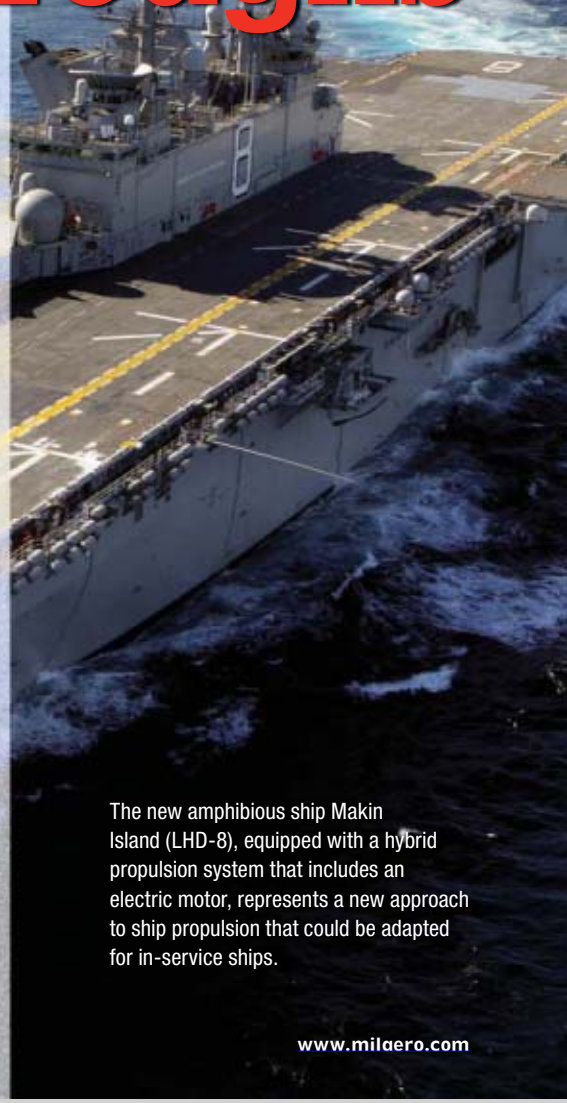
Open-architecture and COTS technologies are critical for advances in ship propulsion, navigation and guidance, weapons control, ballistic missile defense, modular mission packages, and related systems for the nation's maritime defense.

By EDWARD J. WALSH

The U.S. Navy achieved significant shipbuilding and technology development milestones in 2009, recovering from the previous year, which was marked by cost overruns in the Zumwalt-class destroyer (DDG-1000) and Freedom-class littoral combat ship (LCS-1) programs that led to congressional criticism.

Last October, Chief of Naval Operations (CNO) Adm. Gary Roughead announced top-level initiatives to address widely perceived shortcomings in the coordination of Navy acquisition goals and strategy. He established a Naval Warfare Integration Group "to assess the alignment between Navy warfare strategy and investments, and to provide CNO recommendations on how best to improve the Navy's ability to deliver the capability, capacity, and strategy needed to meet national and combatant commander needs."

The new group also is to identify gaps in the Navy's plans "to deliver expected capability and capacity in key warfare areas across platforms and communities." The CNO also consolidated the job of director of



The new amphibious ship Makin Island (LHD-8), equipped with a hybrid propulsion system that includes an electric motor, represents a new approach to ship propulsion that could be adapted for in-service ships.

The Navy plans to purchase 55 littoral combat ships (LCS), which will be fitted with mission modules for anti-submarine, anti-surface, and mine warfare. These photos show Freedom (LCS-1) conducting help certification and Independence (LCS-2) underway during trials.

naval intelligence and deputy CNO for communications networks and other information-related capabilities into a new deputy CNO for information dominance.

In December, Congress approved the 2010 defense appropriations bill, providing $12.5 billion for seven ships: one Virginia-class attack submarine, one Arleigh Burke-class (DDG 51) destroyer, two logistics ships, two littoral combat ships instead of three sought by the Navy, and one joint high-speed vessel (JHSV). The budget also funds completion of DDG 1000 and the tenth San Antonio-class amphibious ship, as well as advances procurement for two more Burkes and a new America-class (LHA 7) amphib.

The 2010 CNO Guidance document mentions only briefly the "truncating" of the Zumwalt class to just three hulls and cites the restarting of the Arleigh Burke production line to build nine to 12 more, which would join the long-planned '51 class of 62 ships.

The Burke restart decision followed extensive Navy studies of both programs that

U.S. Navy's littoral combat ships (LCSs), like the one shown above, are designed to be small, fast, maneuverable, and relatively inexpensive.

showed that while the DDG-1000 is superior in most combat capabilities, the DDG-51 Aegis combat system can be more easily upgraded for ballistic missile defense. The Navy also argued that while the DDG-1000 will be manned by a crew of only 142 personnel compared to more than 300 for the Burkes, the savings in manning costs will be outweighed by the higher costs of maintaining the DDG-1000's advanced systems.

An October 2009 Congressional Research Service (CRS) study noted that Navy officials, in congressional testimony and in other statements, cited a changed assessment of the threat and a greater need for anti-air warfare, open-water anti-submarine warfare, and ballistic missile defense to be the primary missions of the Burke class. The CRS reported the Navy's cost estimate of the first two DDG-1000s came to more than $6.6 billion, with the third costing more than $2.7 billion.

Building more DDG-51s, Navy and industry officials say, will mean the termination of the CGX future cruiser program that was being studied as a replacement for the 22 remaining Ticonderoga-class (CG-47) Aegis cruisers now in service. The modernized Burke design also may evolve into a Future Surface Combatant, 18 of which were planned through 2022.

Underlining its continuing focus on new capabilities for coastal, or littoral operations, the Navy completed important acquisition steps for the LCS and the JHSV—a new class of fast transport ships to be built for the Navy and Army to move personnel, vehicles, and equipment within operational theaters. In December, JHSV builder Austal USA's Mobile, Ala., shipyard began fabrication work for the first JHSV, set for delivery in 2012.

In November, Northrop Grumman's Newport News, Va., yard laid the keel for aircraft carrier USS Gerald R. Ford (CVN-78), first of a new three-ship Ford class of big-deck carriers. Ford is scheduled for delivery in 2015. The yard will start work on CVN-79 in 2013 and on CVN-80 in 2015.

Although the Navy suffered a costly blow with the grounding of the Aegis cruiser USS Port Royal (CG-73) in February 2009 in Hawaii, requiring an estimated $40 million in repairs, a large-scale modernization of the Aegis combat system aboard the 22 cruisers and the Burke destroyers continued to move forward.

Commercial computer technology

The Navy's Program Executive Office for Integrated Warfare Systems (PEO IWS) continued to push Navy and industry systems engineers to comply with its Open Architecture (OA) initiative, which requires the use of commercial computing standards for combat system architectures to maximize commonality and portability for system upgrades and the use of commercial hardware and software.

The DDG-1000s, displacing nearly 15,000 tons, were planned initially to provide fire support for Marine Corps and Army units ashore from greater ranges than possible with the current fleet. The Zumwalts will be armed with two 155-millimeter advanced gun systems with ranges beyond 50 nautical miles, and will launch missiles against land targets from an automated "peripheral" vertical launch system.

In early 2009, the Navy, General Dynamics, and Northrop Grumman agreed that all three Zumwalt destroyers would be built at GD's Bath, Maine, shipyard. Northrop Grumman's Pascagoula, Miss., yard became the lead for the restarted Burke program, but would continue to build the composite DDG-1000 deckhouse.

In February 2009, Bath started construction of Zumwalt under a $1.4 billion contract awarded in early 2008. Work on DDG-1001, the USS Michael Monsoor, is scheduled to start this year.

Also in February, Raytheon Network Centric Systems in McKinney, Texas, delivered for Zumwalt the first production equipment for its cooperative engagement capability (CEC), which processes sensor data from multiple CEC-equipped ships to produce composite target data pictures accessible by a CEC network. The CEC is fielded to Aegis cruisers and destroyers, carriers, big-deck amphibs, and E-2C Hawkeye surveillance aircraft.

In late November, the Navy awarded a $241 million contract to Raytheon Integrated Defense Systems in Tewksbury, Mass., which is acting as DDG-1000 systems integrator, to write software that integrates DDG-1000 machinery control and damage control systems. The new programs will provide computer graphics user

The SM-3 ballistic missile defense weapon now in development will be derived from the design of the SM-2 air-defense missile, shown at right being launched from the Aegis cruiser Princeton (CG-59).

interfaces and technical data management for the ship's integrated power and propulsion system that permit interoperability and compliance with the Navy's Open Architecture initiative.

The machinery control programs also will be integrated with the DDG 1000 total ship computing environment (TSCE), which networks sensor, weapon, and other ship systems.

Earlier in the fall, Raytheon IDS and the Navy completed a critical design review for the X-band/S-band dual-band radar (DBR), which the company provides for DDG-1000 and the new Ford-class aircraft carriers. The review found the DBR, already in production for Zumwalt, is ready for production for the Ford.

The X-band system, designated SPY-3, is a high-frequency (10 gigahertz) radar for horizontal and "on the deck" surface search, periscope detection, and navigation. The lower-frequency (3 GHz) S-band segment, or volume-search radar, developed by Lockheed Martin Mission Systems and Sensors (MS2) in Syracuse, N.Y., conducts high-altitude search.

Raytheon and Navy officials say that the DBR will be the primary sensor for both classes, and can be modified for ballistic missile defense.

Raytheon IDS partnered with a small business, KaZak Composites of Woburn, Mass., to introduce for the Zumwalt a ballistic screen fabricated from composite material by means of a company-unique "pultrusion" process. The company says that the process consists of pulling a woven fabric through a heated resin; the resin penetrates the fabric to form the hardened composite. Meanwhile, in December 2009, Northrop Grumman Shipbuilding won a fixed-price $171 million contract for long-lead materials for restarting the DDG-51 production line.

Littoral combat ship

The LCS program seeks one ship class capable of conducting anti-surface, anti-submarine, and mine countermeasures with modules customized for each mission that are loaded and offloaded as required. The LCSs will be manned by a crew of 40, with additional personnel to operate the mission modules.

In September 2009, the Navy announced that it would cancel the current LCS solicitation and instead award a fixed-price contract in 2010 to one industry team for an LCS design of as many as 10 ships. The initial award would be for two ships in 2010 with options out to 2014. The winner would provide an LCS combat system for five additional ships. A second competition may build ships beyond 2014.

Navy officials said the decision to drop the previous two-team strategy was based on funding constraints, but that the Navy remains committed to a requirement for 55 LCSs.

The decision prompted a letter in early December from U.S. Sen. Richard Shelby, R-Ala., home of General Dynamics partner Austal USA, to Navy Secretary Ray Mabus,

arguing that "the draft request for proposal emphasizes cost as the decisive factor in the design decision, placing technological advancements as secondary criteria. This means that price is more important than quality and that performance is not a critical factor."

The 2010 defense appropriations bill requires the Navy to submit monthly reports on LCS construction costs, in part because of the cost overruns for the LCS program that led the Navy to terminate contracts for LCS-3 and -4 two years ago. In December, the Navy announced that the fixed-price contract for LCS-3 awarded to Lockheed Martin MS2 and Marinette Marine Corp. is worth $470.8 million for construction and related costs, but not government-furnished equipment and systems. The General Dynamics-Austal USA contract for the same tasks for LCS-4 is valued at $433.7 million.

The shaky start for LCS led the Program Executive Office for Ships, Rear Adm. Bill Landay to initiate a major reassessment of Navy shipbuilding strategy.

"We didn't get LCS right up front," he said last fall. "Getting it right means seeking stable requirements, technology maturity, and a properly staffed PEO." Technology must provide capabilities needed at acceptable risk levels and reasonable cost, he added.

In November 2009, the Navy commissioned lead ship USS Freedom, built by the Lockheed Martin-Marinette Marine team. Freedom completed at-sea acceptance trials in May 2009 and combat system ship qualification trials in December. Last January, the Navy commissioned USS Independence (LCS-2), built by the General Dynamics-Austal USA team.

In December, Austal USA laid the keel for USS Coronado (LCS-4). Marinette Marine laid the keel for USS Fort Worth (LCS-3) in July. Both Coronado and Fort Worth are scheduled for delivery in 2012.

The Lockheed Martin-Marinette Marine LCS design is for a high-speed semiplaning monohull 379-feet long that displaces 3,089 tons. The GD-Austal design is a three-hulled trimaran with a stabilized monohull 417-feet long displacing 2,794 tons. Both ships are armed with a Mk110 57-millimeter naval gun system provided by BAE Systems.

Both LCS programs have developed new ship combat management systems. General Dynamics Advanced Information Systems is building an LCS Open Computing Infrastructure or "Open CI" that company officials say supports the austere LCS crew by automating many tasks.

The Zumwalt (DDG-1000) destroyer program now will end at three ships, but will demonstrate many groundbreaking ship-system technologies.

GDAIS officials say that Open CI will enable the LCS command center, manned by three crewmen, to integrate navigation and ship control with the functions of a combat information center. Watchstanders will use one workstation to view navigation, ship control, combat systems, power, and propulsion systems data.

The company says that the system is based on work by Digital System Resources, a small Virginia company acquired by GD in 2003, which developed critical middleware for the Navy's Acoustic Rapid COTS Insertion (ARCI) initiative that slashed the time necessary to field computing upgrades for attack submarines.

Lockheed Martin says that its LCS combat system, called COMBATSS-21, also fully OA-compliant, is derived from the Aegis combat system and the SQQ-89 surface-ship sonar aboard Aegis ships.

Ship electronics and weapons

Modernization of the Aegis combat system for the Ticonderogas and Burkes, under contract to longtime Aegis prime Lockheed Martin MS2, is based on moving the Aegis programs to new OA-compliant "advanced capability builds" (ACBs).

The initial effort, the cruiser modernization baseline for CG-52 through CG-59, consists of a new ACB-08 computer program and a computer hardware upgrade or technical insertion (TI-08). ACB-08 introduces a range of OA upgrades for processing, displays, and anti-air warfare systems. The Navy certified ACB-08 for fleet deployment in November 2009 after at-sea testing aboard the cruiser USS Bunker Hill (CG 52). Two more CGs—USS Mobile Bay and USS Philippine Sea (CGs 53 and 58) started testing with ACB-08 in November. Lockheed Martin is incorporating for the cruiser program an air tasking attribute correlator developed by Lakota Technical Solutions of Laurel, Md.

The remaining cruisers, CG 60 through 73 and Burke-class destroyers DDGs 51 through 78 will be upgraded through the Aegis modernization baseline with a new ACB-12 Aegis program.

Jim Sheridan, Lockheed Martin's director for U.S. Navy Aegis programs, says that ACB-12 will introduce still more new capabilities, including naval integrated fire control and counter air (NIFC-CA), the SM-6 extended-range air-defense missile, Common Processing System, and an enhanced ballistic missile defense (BMD) capability, which is enabled by a multimission signal processor (MMSP).

The ACB-12 software and new hardware will extend the BMD capability already fielded aboard 19 U.S. Navy and two Japanese Aegis ships. Lockheed Martin won a $78.6 million Navy contract in early 2009 for new BMD development that will introduce the company's 4.0.1 BMD equipment suite.

In June 2009, Lockheed Martin installed the 4.0.1 BMD suite, including a BMD signal processor, referred to as BSP, aboard the cruiser USS Lake Erie (CG-70), anticipating Navy certification in 2011. Ships already BMD-capable are being upgraded with a newly certified program, Aegis BMD 3.6.1, which provides the ability to destroy short-range ballistic missiles in terminal approach. ACB-12 is scheduled for testing aboard CG-62 and DDG-53 in 2012. Also in 2012, the BMD 4.0.1 suite, with addition of the MMSP, will be upgraded to BMD 5.0.

Mercury Computer Systems in Chelmsford, Mass., a longtime provider of COTS-based processors for the Aegis program, will deliver to Lockheed Martin its Ensemble 7100 processor for integration with the MMSP. Mercury also is providing its PowerStream 7000 processor for the BSP as

an element of the 4.0.1 BMD upgrade.

In October, the Missile Defense Agency awarded Lockheed Martin a $1 billion contract for continued work on integrating BMD into the Aegis modernization baseline and to support BMD development for allied navies.

Lockheed Martin is teamed with GoAhead Software Inc., a Seattle-based small business that with several corporate partners founded the Service Availability Forum (SAF), which establishes commercial software standards for commercial companies.

GoAhead provides its Self-Reliant middleware to perform resource management functions for ACB-08 and –12, and has developed a new product, called SAFfire, that will support future ACBs. GoAhead also is supporting Lockheed Martin's work on the LCS COMBATSS-21 combat system, and with the Royal Australian Navy for installation of the Aegis system aboard the Australian Hobart-class air warfare destroyers.

In January, GoAhead joined the industry team led by Global Technical Systems (GTS) to provide the SAFfire middleware for the Navy's Common Processing System. The SAFfire, through its dynamic resource management functionality, ensures reliability of critical CPS applications.

Tyson Moler, director of Federal systems for GoAhead, says that the Navy identified SAF standards as a CPS requirement.

GTS won a $95 million Navy contract in March for the CPS development, leading a team that also includes Northrop Grumman Maritime Mission Systems, IBM, and DRS Technologies.

According to GTS, the CPS "provides processing, memory, storage, and input/output to host software applications of Navy combat systems." The GTS program went through a critical design review in December, and is building CPS first-article test units, which will be housed in a modular advanced COTS enclosure cabinet.

Open Architecture remains the foundation for fleet combat systems modernization. In early January PEO IWS Rear Adm. Terry Benedict said that the Navy achieved its 2008 OA goals, including decoupling combat system hardware from software, separating development of systems from platforms, "componentizing" combat systems architectures, and establishing a common objective architecture for combat systems.

Benedict cited the certification last June of an OA-compliant ship self-defense system (SSDS) upgrade for the carrier USS Nimitz (CVN-68), certification of the ACB-08 program aboard Bunker Hill, and the ongoing work on ACB-12.

The Navy will introduce a new ACB every two years and a new technical insertion every four years, he said. ACB-14 will provide OA common components for the MH60R helicopter. PEO IWS expects to multiply the number of OA-compliant components within each ACB through 2022.

The Navy Aegis SM-3 BMD missile, developed by Raytheon Missile Systems and based on the company's SM-2 missile design, will be fielded in several variants.

SPECIAL REPORT

The Navy's Aegis cruisers and destroyers are going through an extensive combat-systems upgrade that will add extensive new capabilities, including ballistic missile defense. Shown here: the cruiser Cowpens (CG-63) and the destroyers Fitzgerald (DDG-62) and Mustin (DDG-89) underway in the Pacific.

Launched from the Mk 41 vertical launch system of Aegis CGs and DDGs, the SM-3 is guided to the target and destroys it with a high-energy kinetic warhead.

In June 2009, Raytheon, with the Missile Defense Agency and Japan's Defense Ministry, completed a joint system design review of the SM-3 Block 2A, the newest SM-3 iteration. Flight testing is scheduled to start in 2012. A month later, the company completed a critical design review of SM-3 Block 1B, aiming at flight testing this year.

The Block 1B adds a throttlable divert and attitude control system and replaces the Block 1A's single-color seeker with a two-color all-reflective infrared seeker, which the company says will enable longer-range acquisition and more precise threat discrimination. The Block 2A will introduce 21-inch second- and third-stage rocket motors, and a more lethal kinetic warhead.

In August, Raytheon completed airframe and autopilot testing for the SM-6 air-defense missile. The SM-6, Raytheon says, incorporates the advanced signal processing and guidance control of the company's advanced medium-range air-to-air missile.

In September, the Navy awarded Raytheon a $93 million contract for low-rate initial production of the SM-6. Also in September, the company won a $151 million contract for 186 upgraded Evolved Sea Sparrow missiles (ESSMs), with an option for 255 more. The ESSM is a primary air-defense weapon for the Aegis ships,

In addition to innovations for combat systems and weapons, the Navy is seeking a new air and missile defense radar (AMDR) for DDG-51s or a Future Surface Combatant. In July, the Navy awarded $10 million contracts to Lockheed Martin MS2, Raytheon IDS, and Northrop Grumman Electronic Systems—builder of the air-search SPQ-9B radar, an element of the Aegis modernization—for six-month concept studies of an scalable AMDR that integrates X-band and S-band capability for

defense against future airborne and ballistic missile threats.

Power and propulsion

The Navy will achieve key gains in ship power and propulsion systems through the introduction for Zumwalt of an electric-drive integrated propulsion system (IPS), a longtime goal for the surface fleet, which is based on one power plant to generate power for propulsion, weapons, and sensors, and ship services.

The IPS uses an electric motor to power the propeller shaft and a zonal power distribution system to transmit power among ship systems. It eliminates the need for large reduction gears and reduces the number of gas turbine or diesel engines required. Because the motor could be linked to the propellers by cabling instead of a lengthy shaft, IPS allows ship designers to rethink hull space allocation.

The Navy initially planned to introduce a high-torque permanent magnet electric motor for the Zumwalt IPS. Due to concerns about technology risk, the program selected instead a more mature advanced induction motor built by Converteam, formerly Alstom.

The full-up IPS design won't be an option for already-fielded ships, which might receive electric drive through a "hybrid" design that integrates an electric motor with the conventional gas turbine or diesel engine plant. In July 2009, the Navy awarded a contract to a team of General Atomics and DRS Technologies to design a hybrid drive system for the Burke-class destroyers and possibly other vessels.

The system consists of power electronics provided by team lead General Atomics and a DRS permanent magnet motor. The team will deliver the drive system in 2011 to the Navy's Philadelphia land-based test laboratory for testing. The drive then will go aboard the destroyer USS Truxton (DDG-103) for at-sea tests in 2012.

Glen Sturtevant, director of science and technology for PEO Ships, says that while the Navy continues to focus on integrated electric drive for new ships, the hybrid system will be a power-saving solution for the in-service fleet.

He points out that while the LM2500 gas turbine engines that power the Ticonderoga-class cruisers, Burke-class destroyers, and other ships are built for peak efficiency at top speeds, those ships often operate at lower speeds. By using a fuel-efficient electric motor for low-speed transit, it is possible to shut down one of the gas turbines to achieve considerable fuel savings.

USS Makin Island (LHD-8), the last of the Wasp-class, big-deck amphibs, which was commissioned in October, is built with a hybrid mechanical-electrical power plant. The ship demonstrated the promise of the hybrid design when it saved some $2 million in fuel during transit last summer from Pascagoula, Miss., to San Diego, according to PEO Ships Rear Adm. Landay.

North Atlantic Industries of Bohemia, N.Y., a manufacturer of embedded power system components, provided for Makin Island its NAI 64C1 multifunction card, which performs machinery control through monitoring of input/output signals for hatches, valves, engines, and other functions. The 64C1 also is capable of monitoring I/O signals for power management, navigation, and weapon systems functions.

The Office of Naval Research's Sea Warfare and Weapons Department is sponsoring research supporting the IPS and hybrid systems, including advanced switches and power controllers needed for bi-directional distribution of power that allows storage of excess power in an energy storage module.

ONR also has sponsored development of a high-temperature superconducting motor and collaborated with the Defense Advanced Research Projects Agency to build a prototype of a solid-state transformer. The motor and the transformer are being tested at the Philadelphia land-based test site.

An important ONR initiative, officials say, is development of a medium-voltage DC distribution system, which would eliminate the need for circuit breakers and transformers.

ONR also sponsors an Electric Ship Research and Development Consortium of seven universities, based at Florida State. The consortium is developing modeling and simulation software that creates physics-based models of a shipboard electrical distribution system and other IPS components.

TECHNOLOGY FOCUS

Empowering embedded computing

Mainstream, COTS technologies combine with aerospace and defense industry innovations to deliver increased performance in compact electronics designs

By **COURTNEY E. HOWARD**

It is frequently the case in a challenging economy that enterprises must do more with less. The world's military organizations, as well as the technology firms and contractors that serve them, are no different.

In the realm of embedded computing in military and aerospace applications, systems engineers and integrators are plagued with the challenge of providing greater functionality in a smaller, lighter, and less costly package. Many are meeting, and even exceeding, this goal through the employ of commercial off-the-shelf (COTS) technologies.

Processing power

"Embedded processors are going the way of mainstream computing," says Mark Snyder, vice president of product management at Alt Software in Phoenix. Mil-aero systems "are trending toward smaller, cheaper, lower power, and higher performance. They are morphing toward programmable multicore or parallel floating-point architectures, such as programmable GPUs [graphics processing units], and away from standard uniprocessor and dedicated ASIC [application-specific integrated circuit] architectures. The future holds much more of this."

A fundamental shift in which systems designers are replacing discrete systems and components with programmable counterparts is happening throughout virtually all aerospace and defense applications. A system's ability to multitask, or fulfill several different roles, is key.

Systems designers increasingly are requesting long-life solutions that either reduce or eliminate their dependency on discrete graphics boards and chips, Snyder acknowledges. They want to embrace programmable graphics accelerators for their graphics, video, and parallel-processing capabilities, but they also need to meet traditional military and aerospace requirements for safety certification, reliability, and robust operation.

Mil-aero firms are turning to Alt Software to meet myriad GPU needs, such as powering embedded display, situational awareness, and, increasingly, parallel and sensor processing systems. "Our customers are requesting, for instance, capabilities to replace traditional methods of processing pixel-intensive information, such as DSPs and FPGAs, with software-programmable methods using standards, such as Khronos Group's OpenCL" and OpenGL ES 2.0, says Snyder.

Aitech's NightHawk RCU is a rugged, compact, Intel Atom-based, self-contained control unit that weighs 4.5 pounds, boasts a slim profile, and delivers natural convection/radiation cooling.

Driving displays

Engineers at Alt Software developed software drivers for the Fujitsu Ruby graphics display controller on Green Hills Software's Integrity real-time operating system (RTOS). "In this case, Alt was selected to bring OpenGL ES 2.0, the standard graphics API [application program interface} used on devices such as the Apple iPhone, to the mil-aero space on a hard real-time OS," Snyder explains. "Green Hills wanted their customers to be able to leverage the vast pool of developers familiar with these new graphics standards, and therefore open up mil-aero platforms to the latest capabilities enjoyed by consumers.

"Fujistu's Ruby graphics subsystem provides a discrete GPU core that offers an ideal bridge for bringing these capabilities into the existing mil-aero processing world," Snyder adds. "Ruby provides full programmability, meaning application developers can design innovative media-accelerated applications that offer new ways to process and display data, all in a low-power form factor that can be easily integrated into existing system architectures."

Many mil-aero systems designers are interested in system-on-a-chip (SoC) architectures or adding GPU cores to their own FPGA or software-based designs, Snyder says. "We will see the advent of more SoC systems, such as Intel Atom- and ARM-based SoCs, making it into mainstream mil-aero systems. Embedded computing will follow the path of our smart phones, iPads, and netbooks, and the mil-aero community will have key challenges to adapt their software and system development mentality to these trends."

Executives at Curtiss-Wright Controls Embedded Computing (CWCEC) in Leesburg, Va., are also seeing increased interest in GPUs for signal processing. Mil-aero systems designers are considering

New Aitech NightHawk RCU™ Controller:

Better SWaP with fewer tradeoffs.

Harness improved processing and SWaP efficiency in the free air-cooled Aitech NightHawk RCU™. The NightHawk is a PC-based, rugged processing and I/O controller unit ideal for demanding defense, aerospace or rugged commercial environments including manned/unmanned ground or airborne vehicles, as well as Data Concentrator Unit (DCU) or Remote Interface Unit (RIU) applications.

*Minimize weight...*at just 4.5 lbs., this space-saving unit delivers exceptionally efficient SWaP performance in a slim-profile 195-in.^{3} package.

*Expand I/O versatility...*including 18-36 vdc input, a complete set of standard PC I/O interfaces, video camera input and dual independent video outputs for true hi-def XGA and standard TV displays, plus extensive internal expansion support to add peripheral I/O interfaces for military/industrial embedded apps.

*Enhanced processing efficiency...*with a low-power Intel® Atom™ (Navy Pier) 1.6 GHz RISC microprocessor, 2 GB DDR2 SDRAM and 8 GB SSD memory, plus optional CompactFlash or 250 GB Solid State Disk (SSD) storage.

*Take rugged to greater extremes...*with an environmentally sealed, extruded aluminum housing in an innovative convection/radiation cooling design that dissipates more than 22 W at +55°C. Along with military standard 38999 connectors, the sealed NightHawk protects against windblown fine dust and sand particles, while numerous EMI/RFI features meet MIL-STD 461 emission and susceptibility limits, in a shock-, vibration-, and corrosion-resistant design for harsh mechanical, climatic, chemical and electrical environments.

*Maximize your options...*with the flexibility to configure the NightHawk RCU™ into the control unit you need it to be. Contact us today for detailed power and I/O specifications.

Photography Courtesy of Lockheed Martin

Aitech

Aitech Defense Systems, Inc.
19756 Prairie Street
Chatsworth, CA 91311
email: sales@rugged.com
Toll Free: 888-Aitech8 - (888) 248-3248
Fax: (818) 407-1502
www.rugged.com

25 Years of Success

"high-end GPUs from Nvidia [Santa Clara, Calif.] and ATI [a brand of AMD in Sunnyvale, Calif.] for signal-processing applications," says Steve Edwards, chief technology officer at CWCEC. "Especially in radar and signal intelligence applications, in which they would have used banks of processors or FPGAs, they are investigating GPUs for signal processing." Innovation in this specific area, in fact, is high on CWCEC engineers' research-and-development list for 2010.

Graphics demands

"People are demanding more processor and memory performance in smaller footprints," explains Chip Thurston, technical director at Crystal Group in Hiawatha, Iowa. "Gone are the days of a 450 MHz, low-power XScale CPU and 512 megabytes of memory," he says. "Mobile and embedded applications are now looking to do full-resolution mapping, 3D imagery, and checking e-mail—all without multiple machines."

U.S. Navy officials are among the mil-aero systems designers requiring greater graphics performance. In the modernization of Navy destroyer warships, officials elicited the expertise of engineers at General Micro Systems (GMS) in Rancho Cucamonga, Calif.

"All the hardware used in the modernization of machinery aboard DDG destroyers is from GMS," notes Ben Sharfi, GMS chief executive officer and founder. "It was a refurbishment and remodernization of the embedded electronics, which exclusively are VME-based, 6U, air-cooled, semi-ruggedized systems."

Today's Navy requires lots of functionality in a single box: graphics, performance, and storage, Sharfi says. The system must be powerful enough to handle huge databases, drive several monitors and repeaters, and accommodate RAID controllers. S.I.E. AG (formerly Carlo Gavazzi) in Brockton, Mass., provided the chassis for these programs.

Size and weight, common priorities in mil-aero systems, are not terribly important factors when it comes to Navy destroyer modernization. "Adding another 20 pounds to a carrier is not that big of a deal," Sharfi explains. "What is important is graphics functionality and compatibility with legacy equipment—what they have on the ships already."

The Zumwalt-class destroyer DDG-1000 is a multimission U.S. Navy surface combatant ship designed to operate as part of a joint maritime fleet, assisting Marine strike forces ashore as well as performing littoral, air, and sub-surface warfare. The DDG 1000 takes advantage of embedded computing provided by General Micro Systems. (U.S. Navy illustration.)

GMS was selected in part for its willingness to modify its hardware to fit the Navy's existing infrastructure. "We knew the infrastructure and backbone were not going to change," Sharfi says. "We provided both flexibility and customization. We modernized, but left the physical interface the same as what was already in place. If you look at most hardware makers, they are going with only new stuff."

The demand for increased graphics functionality is not exclusive to the Navy. The U.S. Coast Guard and Homeland security and law-enforcement agencies likewise seek high-end graphics and video capabilities.

Curtiss-Wright Controls is fulfilling this need with rugged video display, distribution, and recording technologies that the company gained with its acquisition of Skyquest Systems of Basildon, England, in Dec. 2009.

"More and more, our customers want us not only to provide the box, but also to hook it up to a rugged display," CWCEC's Edwards says. High-end graphics and video are pushing into rugged deployments, providing opportunities to deliver high-definition screens in helicopters, several camera sensors outputting to video recorders for immediate archival, and video distribution and display solutions.

CWCEC engineers are currently working with police agencies and the Coast Guard to deliver video surveillance solutions. "We are also bringing this technology to [the U.S. Department of Defense] to meet the demand for 360-degree awareness on the battlefield," says Michael Macpherson, director of business development at CWCEC.

Solid-state storage

The increased need for video and graphics content is driving the requirement for greater data storage capacities. All the intelligence data being captured by myriad sensors must be stored, after all.

In response to increased storage demands, the aerospace and defense electronics community is rapidly moving to solid-state disks (SSDs), says Thurston. "As the commercial market has pushed capacities upwards, mil-aero customers have jumped at the chance to move long-term storage of applications and data onto solid-state disks."

Costs are coming down, and mil-aero program managers and end users want SSDs, Sharfi mentions. An important aspect, however, is secure erase capability—an area in which GMS and other firms are innovating.

CWCEC engineers are putting a lot of resources and intelligence around not only information security and data protection, but also the notion of trusted COTS; that is, the ability to protect the technology.

"There is a need to protect critical technologies used in unmanned systems as part of foreign military sale," Macpherson cites as an example. "We are adding features and capabilities to enable the protection of data and the technology itself."

Themis' New Rugged Servers Have Speed to Burn and Keep Their Cool.

New! 1RU RES Servers

- One or two Intel® Quad-Core 5500 Series Xeon® CPUs with Intel Nehalem Microarchitecture
- Up to 96GB ECC SDRAM
- Up to 3 removable and lockable 2.5" HDDs
- One PCI-E 2.0 x16 slot, optional SAS expansion

RES-12XR3 server shown with optional filter door panels.

New! 2RU RES Servers

- One or two Intel Quad-Core 5500 Series Xeon CPUs with Intel Nehalem Microarchitecture
- Up to144GB ECC SDRAM
- Up to 8 removable and lockable 2.5" HDDs
- Up to 7 expansion slots (PCI-E and PCI-X)

A New Era of Performance and Rugged Reliability

Themis' new family of XR3 Series of Rugged Enterprise Servers™ (RES) includes the latest Quad-Core Xeon processors and Nahelam Microarchitecture from Intel.

These new Intel chips revolutionize server performance, and Themis' robust designs – only 20" depth - provide the reliability to keep mission critical applications running. Themis servers provide far greater reliability, improved life cycle management and substantially lower TCO than other COTS systems solutions.

Features in the RES-XR3 servers include:

- Dual redundant, hot-swappable power supplies
- Dual redundant DC power option
- Operating shock - 3 axis, 25G, 20ms
- Operating vibration - 3.0 Grms, 8Hz - 2000Hz
- Light weight, corrosion resistant, 20" depth chassis
- Optional air filter door panels

So when the environment gets tough and your data is critical, turn to the company that builds systems to perform in the harshest conditions. For Sun® Solaris™, Linux®, and Microsoft® Windows® environments. For more information on Themis' rugged new servers, please visit us at www.themis.com.

Themis rugged, mission-critical computers.
Designed to take it.

www.themis.com (510) 252-0870

New! 3RU RES Servers

- One or two Intel Quad-Core 5500 Series Xeon CPUs with Intel Nehalem Microarchitecture
- Up to 144GB ECC SDRAM
- Up to 8 removable and lockable 2.5" HDDs
- Up to 7 expansion slots (PCI-E and PCI-X)

RES-32XR3 server shown with optional filter door panels open.

THEMIS

Transformational.

Multiple cores

The future will bring embedded and mobile applications having better performing video, as the video controller will likely move onto the CPU (central processing unit), Thurston says. "More system functionality will eventually be brought into the processing unit, which should allow for lower power requirements, more computing capability, and smaller devices.

"Rather than increasing processor clock speed," Thurston adds, "over the past couple years, we have seen an increasing number of cores present in the processor, and new technologies—such as the introduction of additional thread handlers via hyperthreading, and the increase of memory bandwidth by putting the memory controller directly on the processor itself."

Crystal Group's latest rugged embedded computer, the TCM2 (Tactical Computing Module 2), takes advantage of a dual-core 2.53 GHz Intel Core 2 Duo CPU. The small-footprint (11x12.75x3-inch), high-performance embedded computer is designed to withstand aggressive temperatures (-40 to +65 degrees Celsius) and 7.18 GRMS of random vibration, as well as run on conventional 120-volt vehicle power. It also offers up to 8 gigabytes of RAM and two 2.5-inch hard drives or SSDs, expandable to as many as eight additional 2.5-inch drives with a slim expansion base.

The hottest multicore news of late is the 2010 Intel Core processor family, including the Intel Core i7, born of the company's 32-nanometer production process. Following Intel's release of the series during the 2010 Consumer Electronics Show, technology firms serving the mil-aero community—including Adlink Technology in San Jose, Calif.; CWCEC; Extreme Engineering Solutions in Middleton, Wis.; GE Intelligent Platforms in Charlottesville, Va.; and Kontron in Poway, Calif.—introduced embedded innovations that take advantage of the 32-nanometer processors.

Kontron announced the integration of the new Intel Core i7 processor across numerous platforms found in military design, including AdvancedMC, CompactPCI, COM Express, and VPX, describes Thomas Sparrvik, vice chairman of Kontron. "Using the 32-nanometer manufacturing process for exceptional performance per watt and lower power consumption and heat dissipation, Kontron's new Intel Core i7-based platforms utilize a more efficient two-chip solution that provides better signal integrity and minimizes board space, enabling higher performance in smaller, power-constrained portable designs."

Combat vehicles, such as the Mine Resistant Ambush Protected (MRAP) family, benefit from powerful, yet compact embedded electronics from companies such as General Micro Systems. Shown here are the MaxxPro Dash and MaxxPro Plus from Navistar Defense LLC.

This technology also delivers enhanced integrated graphics capabilities and data flow performance via the integrated Intel QM57 Express chipset and advanced display interfaces, Sparrvik adds. It is, therefore, well suited to visually demanding and compute- and graphics-intensive military applications.

"Applications can now support multiple graphical and multimedia functions," says Sparrvik, outlining further benefits of Intel Core i7 platforms. "Military system design flexibility is increased with an integrated ECC memory controller to match high data integrity requirements. Design flexibility is further improved with additional I/O (input/output) and PCI Express configuration options, and long embedded system life requirements are supported with an extended seven-year lifecycle. Military designers can capitalize on the intelligent, feature-rich Intel Core i7 processor architecture and also satisfy multiple requirements in terms of performance, power, graphics, memory, software compatibility, security, and upgrade path migration." Virtually all these requirements apply to computers embedded within combat vehicles, for instance.

Vetronics

The market for embedded electronics for military vehicles is booming, admits Sharfi. GMS embedded computing solutions are currently employed on Joint Light Tactical Vehicle (JLTV) and Mine Resistant Ambush Protected (MRAP) vehicles, as well as the Warfighter Information Network-Tactical (WIN-T) program.

"A huge amount of spending in the military will be on vehicles," Sharfi continues. The U.S. Army's budget for vehicle upgrades numbers in the billions of dollars, and thousands of vehicles, including Bradleys and MRAPs, will be modernized. "Given these numbers, cost is extremely important, so the cost structure that they are trying to get into is roughly $10,000 for full embedded computers driving high-end graphics, fast I/O, Ethernet, the full temperature range, and military regulations.

"None of these Army units are going to traditional 3U CompactPCI, as has been done historically," Sharfi adds. Part of the reason is size. "Size is king. On Win-T, for example, the big enclosures and racks are out and being replaced with heavily embedded small systems that fit in a box behind the driver." Everything else being equal, the most important consideration is cost and the second is size, he says.

"Traditional, board-level plug-in solutions are out of the question; none of those vehicles are being built with traditional racks," Sharfi says. In fact, GMS's S802 and 802R embedded computer systems, measuring 4x4 inches, are replacing an entire rack, both in direct Army contracts and via systems integrators, he says.

One from many

Virtualization is enabling the replacement of several, preexisting systems with a single embedded computer.

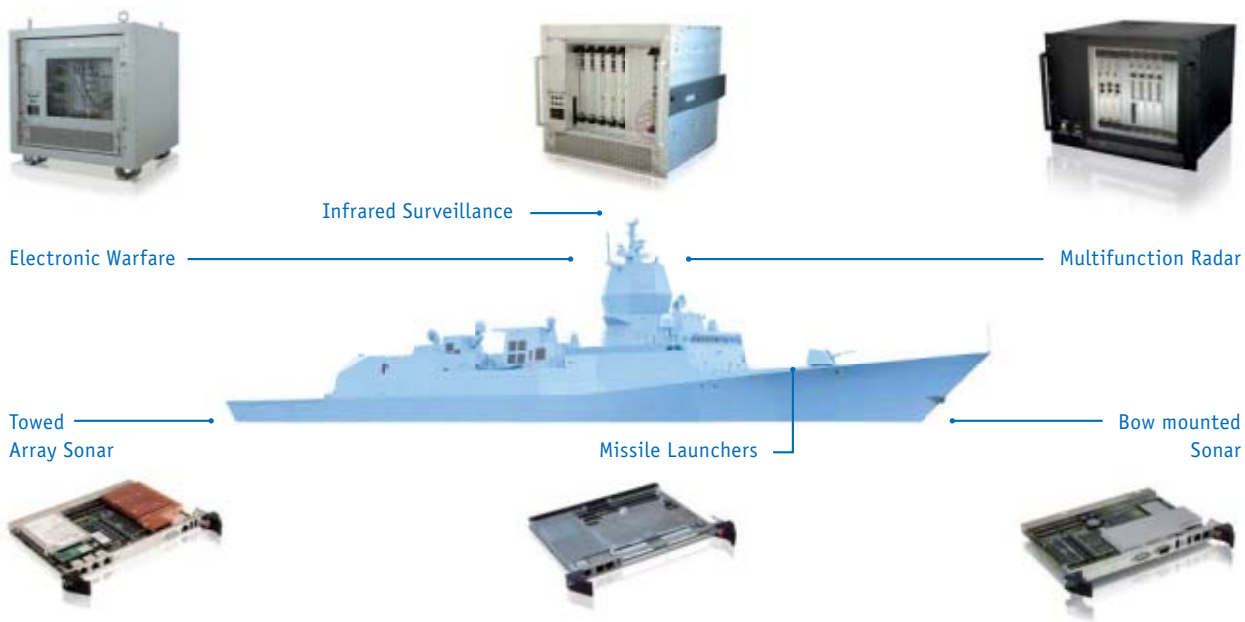
"Win-T removed four servers and replaced them with one GMS box. Why that works is simple: virtualization," Sharfi explains. Many mil-aero organizations are running old software—legacy mapping, diagnostic, communications, and other programs—on Pentium M processors, he continues. "Now, with multicore, we have more than enough horsepower to virtualize multiple machines

kontron

» We Do Not Build Navy Ships «

Our Customers Do.

At the heart of the most advanced command and control systems deployed in Navy ships are Kontron Military Rugged COTS boards and systems. Keeping us safe with smart applications, military contractors look to Kontron for superior technology, performance and life cycle management expertise.



MILITARY RUGGED COTS

Call, Email or Visit today.

Call: 1-888-294-4558
Email: info@us.kontron.com
Visit: www.kontron.com/military

If it's embedded, it's Kontron.

in one machine and have plenty of bandwidth. With virtualization, multiple systems can be removed and a single, small, inexpensive, high-performance embedded system brought in. It is the focus of the U.S. Army, for example. You'll see that trend continue and many companies will do well on this platform."

Virtualization not only frees up space, but also lessens a platform's weight—the top identifier for the U.S. Air Force in its modernization efforts. For every thousand pounds of weight removed, hundreds of thousands of dollars in fuel are saved, Sharfi says. "Weight is king in aircraft. Thousands of pounds of weight can be cut from an aircraft simply by going outside of the traditional way of doing things—such as racks of electronics being replaced by embedded computers that are virtualized." When 12 images run on one system with virtualization, the platform benefits not just from the removal of 1300 pounds of weight, but also from reduced power consumption and cooling needs over the lifetime.

CWCEC officials are "looking at LRU [line replaceable unit] consolidation," says Macpherson. "As modernization programs put more capabilities in platforms, space is not available to add more LRUs. [Military systems designers] want to replace multiple LRUs with one LRU incorporating greater functionality than all the removed systems and taking up half the space. Two enablers are: an increase in processing performance and a consolidation of I/O. Now only two interfaces share information; it used to be 5 to 10."

Adding value

Just as it is now common to replace several systems with a single solution in mil-aero environments, systems designers are trending toward acquiring complete systems rather than components from several sources. Most also now seek "value-added" services.

"Embedded board vendors that offer higher levels of integration in the form of functional subsystems with fully-developed FPGA code, software drivers, and diagnostics will become more attractive to system integrators as a way of minimizing their risk and costs in delivering the final system," says Rodger Hosking, vice president of Pentek Inc. in Upper Saddle River, N.J.

"Customers are working on increasing their value proposition, and asking us to increase ours as well," says CWCEC's Edwards. "As a result, we are seeing more integrated systems sales—for example, a complete subsystem with chassis and power supply, integrated solutions that stop short of the application."

The Kontron AM4020 features new Intel Core i7 processors with 2.0 GHz or 2.53 GHz and a 4 MB L3 cache. The integrated memory controller enables direct access to up to 8 GB of dual channel DDR ECC RAM at 1066 MHz. Compared to previously available AdvancedMC CPU boards with Intel Core 2 Duo processors, customers will experience up to 100 percent higher overall performance.

CWCEC's built-in test (BIT) is an example of a "value add," says Edwards. "When the card powers up, it does a self-check and reports any failures, such as in communications, memory, or between nodes on a board. It really stops at the backplane. It is systems-level, not just modular-level, BIT with some interboard, intraboard, and backplane connectivity testing to ensure that everything is working together and functional."

Interest in integration

It is not enough to ensure that a component or system is working; rather, it must be capable of working in concert with various other electronics—and do so every time, without fail.

"Customers continue to demand embedded solutions with greater subsystems-level integration that actually work together, and as advertised," says Douglas Patterson, vice president of worldwide sales and marketing at Aitech Defense Systems Inc. in Chatsworth, Calif. "In addition, they're looking for flexible levels of customization services and value-added, 24/7 technical support services when something they think ought to work, doesn't."

The basic physics of customer applications haven't changed, says Patterson. "We are still getting requests for full MIL-SPEC [-55 to +85 degrees C] products combined with smaller size, lighter weight, and lower power. This encompasses integrated electronics control subsystems housed in lightweight, environmentally sealed, ambient/passive air or cold-plate [conduction-cooled] rugged enclosures." Aitech is expanding its lower-power, high-performance board and subsystem-level products to address this need, most recently with its NightHawk RCU series.

The NightHawk RCU is a rugged, compact, Intel Atom-based, self-contained control unit that weighs 4.5 pounds, has a slim profile, and delivers natural convection cooling. The solution is suited to use as a

Embedded impact

Several new technologies will start to make their impact in tomorrow's military, says Douglas Patterson, vice president of worldwide sales and marketing at Aitech Defense Systems in Chatsworth, Calif. Among them, in his words, are:

- Lower-power, networked, distributed, and flexible stand-alone processing subsystems better enabling the integrated battlefield;
- New robotic vehicle proliferation, some with integrated ISR and weapons platforms to increase battlefield situational awareness, to conserve warfighter weapons assets with less collateral damage and ultimately saves lives;
- Smaller, lighter, faster, more reliable, generic computing platforms that reduce the need to maintain expensive field spares and lessen "hanger queens";
- Space flight as a "proprietary" transport layer for men and material with installation of new, plasma-based engines for space transport and interplanetary travel; and
- New kinetic-energy (hyper velocity) weapons, guided munitions, and stabilized weapons platforms.

data concentrator unit (DCU) and remote interface unit (RIU) in various military platforms, such as manned, unmanned, ground, and airborne vehicles. The NightHawk RCU can also provide Condition Based Maintenance (CBM) functionality for military tracked and wheeled vehicle applications, reducing the overhead costs of preventative vehicle maintenance.

The newly released NightHawk, based on the low-power Intel Atom processor operating at 1.6 GHz, provides as much as 2 gigabytes of DDR2 SDRAM, as well as between 4 and 8 gigabytes of SSD memory with an optional expansion to as much as 250 gigabytes for extended and remote data collection and storage applications. Its I/O interfaces include two Gigabit Ethernet ports, six USB 2.0 ports, and four multifunction RS232 serial ports, dual graphics/video ports, keyboard/mouse and stereo audio in/output ports, and an I/O set specifically tailored for embedded military applications.

Network connectivity

Network-centric warfare and the Global Information Grid (GIG) have matured, and military programs are starting to require network-ready systems. "The network is part of the systems that are deployed," CW-CEC's Macpherson explains. "Now that we understand netcentric warfare, we need to make sure all systems on a battlefield can connect and all products are able to form a network on the battlefield."

To be effective, a netcentric battlefield requires considerable, readily available bandwidth. "Military design is evolving dramatically based on demands for increased bandwidth and faster, more sophisticated signal processing," Sparrvik says. "The military is focused on using highly reliable technology to its fullest potential, as demonstrated in ongoing initiatives, such as WIN-T and the U.S. Navy's Consolidated Afloat Networks and Enterprise Servers (CANES) program.

"WIN-T is fundamental in defining and advancing the military's secure network communications, with incremental implementation bringing greater levels of networking capabilities to various deployed units and ground command operations," Sparrvik adds. "Full network mobility and more robust connectivity enable greater network access than ever before. CANES, for example, is consolidating and reducing the Navy's afloat information systems networks. Technologies integrated into a CANES program application reduce the size and cost of its technology infrastructure, improve the existing path of legacy applications, and advance command, control, communications, computers, surveillance, and reconnaissance (C4ISR) capabilities in the process."

Programs such as these require advanced technologies that not only deliver performance and low power improvements in smaller footprints, but also meet critical system requirements for high reliability, Sparrvik explains. "High-reliability demands in mil-aero applications will mean that embedded computing platforms will

need to leverage technology advancements along with satisfying more stringent needs for thermal management, mean time between failures (MTBF), and enhanced ruggedization. This translates into additional opportunities for embedded computing solutions, as well as greater demand for embedded systems."

Data transfer

Pentek's Hosking notes a definite shift in new systems toward serial fabric-based system architectures, using PCI Express and Serial RapidIO, to improve board-to-board data transfer rates because of higher signal bandwidths, more powerful FPGAs and processors, and faster peripherals.

Pentek's digital signal processing IP cores for FPGAs are among the highest-performance designs in the industry, according to Hosking. "For example," he says, "Pentek's Model 7151 with four 200 MHz, 16-bit A/D converters features an FPGA IP core that delivers 256 software radio digital down converters (DDCs) in a single PMC/XMC module. As the industry's highest-density DDC, the 7151 is ideal for surveillance of hundreds of communication signals in a small form factor, including unmanned land, maritime, and airborne vehicles."

"The latest FPGA technology and serial fabric interconnects will dominate most designs," Hosking says. "These technologies will increasingly be deployed in PC server systems and in VXS and VPX platforms. Government concerns about the longevity and maintainability of new technology and architectures for embedded systems have mandated the need for industry-wide standards. One notable response has been the OpenVPX initiative and its relatively rapid transition to VITA 65 for ratification and eventual ANSI [American National Standards Institute] approval."

Standards and scalability

"For mil-aero, meeting SWaP [size, weight, and power] requirements continue to drive new designs toward smaller embedded computing form factors, such as 3U VPX, 3U CompactPCI, MicroTCA, and Computer-On-Modules (COMs)," Sparrvik says. "Satisfying program lifecycle requirements, reducing time-to-market, and minimizing the engineering resources needed for a particular application are also very important for mil-aero contractors to remain competitive. Because there are many embedded computing platform options and each brings its own advantages, designers of mil-aero applications are finding it crucial to work with a proven COTS manufacturer to find the optimal platform for their specific design.

"Mil-aero system developers are demanding the ability to scale solutions and add features without dramatically changing the form factor to meet their development and time-to-market goals," Sparrvik adds. "At Kontron, we have developed a broad spectrum of form factors in order to support the dynamic and diverse needs of our mil-aero customers. As platforms such as MicroTCA, VME, VPX, CompactPCI,

and COMs continue to evolve, Kontron is committed to staying at the forefront of embedded technology for military applications and driving standards-based solutions."

One of the big trends in embedded computing for mil-aero applications in the past few years is the move from VME to VPX and OpenVPX, says CWCEC's Edwards. "It has opened a range of applications, not only in terms of the size of systems, but the things you can do with the systems now that you have that much communications bandwidth between the systems. We've seen a number of our customers moving in that direction, especially in a majority of ground-based systems."

VME is still strong in deployed systems, in which the technology is upgraded but the whole chassis is not replaced; however, new platforms take advantage of VPX and OpenVPX, explains Edwards.

CWCEC engineers have delivered the company's first system to be built with

Crystal Group's Tactical Computing Module 2 (TCM2) is a small-footprint, high-performance embedded computer with a 2.53 GHz Intel Core 2 Duo CPU designed to withstand aggressive temperatures and vibration.

VPX components, in fact. Company personnel delivered the radar processing subsystems to Northrop Grumman in Baltimore, Md., for use in the U.S. Marine Corps' Ground/Air Task Oriented Radar [G/ATOR] program and in accordance with a $4.3 million contract.

The High Mobility Multipurpose Wheeled Vehicle [HMMWV]-mounted G/ATOR uses active electronically scanned array technology to provide aircraft detection and tracking, cruise-missile detection and tracking, ground-weapon location, and air-traffic control. Its modular architecture is designed to deliver operational flexibility and the ability to incorporate new processing platforms and technologies as they become available. The rugged, air-flow-through, radar processing subsystem from CWCEC employs open architecture-based standards and software to provide a modular, scalable solution.

"We provided the Radar electronics subsystem to Northrop Grumman, which sits on the back of a mobile combat vehicle," Edwards explains. "We had to custom design a card to handle their proprietary I/O; other cards were COTS. We designed the chassis, power supplies, and a novel cooling approach, as well as qualified systems for their application to sit on—marking a number of firsts for us."

OPINION

Model-based design facilitates compliance to aerospace standards

BY BILL POTTER AND MATT BEHR

Clear design communication, engineering efficiencies, and automatic code generation are some of the benefits that model-based design provides to aerospace design organizations. Recently, many engineers have focused on using model-based design to systematically and continuously test designs through simulations, with a focus on pulling verification activities ahead in the design cycle. This early verification is accomplished by using commercial off-the-shelf (COTS) software so that designers can find errors earlier, when they are easier and less expensive to fix.

While the need to integrate verification into the design cycle is recognized throughout the aerospace industry, it is perhaps most acutely felt in the design of safety- and mission-critical systems. This need arises because, throughout the design cycle, engineers must validate requirements; that is, they must ensure that the thing is built correctly and verify compliance to the requirements. Moreover, engineers must demonstrate traceability from the requirements to the design and provide documentation of this traceability as well as the verification of the design. The mandates span global markets with DO-178B for software and DO-254 for electronics hardware (i.e., ASICs, FPGAs, etc.) in the U.S., and ED-12B and ED-80 standards in Europe.

Importance of standards

All commercial aircraft software and electronics must be certified as compliant to these standards to have authority to fly in commercial airspace. In addition, many defense suppliers are also required to certify military systems or follow processes compliant to these standards for applications such as unmanned aerial vehicles (UAVs). This required compliance is unfamiliar territory for many suppliers and can increase costs and lead to delays.

While the cost of developing certified systems is appreciably high, the resulting quality and reliability increase as well. For instance, in the U.S., the goal of DO-178B and -254 standards for safety-critical systems is one out of a billion probability of causing a crash. Even without an accident, in commercial aerospace, there are government airworthiness directives. If a regulatory agency finds a problem with hardware or software, it could mandate that airlines change or update equipment—which can increase cost and possibly damage the designers' reputations.

> "Model-based design and COTS software tools can streamline the development of certified systems."

Certification authorities expect electronic systems developers to verify their requirements, design, and source code, and to conduct testing on the actual microcontroller, FPGA, or ASIC. Simultaneously, it is necessary to review outputs, maintain traceability, and perform version control for all artifacts throughout the process.

Estimates predict that conformance to DO-178B adds 50 percent to 200 percent to software development costs. One way to circumvent these costs is to integrate verification activities earlier in the design process to ensure conformance to standards. This helps engineers find design errors earlier in the development process, before significant rework and re-documentation is needed.

Help is in the tools

Model-based design and COTS software tools can streamline the development of certified systems throughout design and implementation. These tools can aid designers in four key areas: traceability, requirements validation, verification, and conformance.

To comply with DO-178B or DO-254, each portion of a design must be traceable from requirements to implementation to test cases. With model-based design, engineers can insert traceability links that connect the model to the requirements. This requirements traceability is maintained through code generation by insertion of comments and links in C (DO-178B) or HDL (DO-254). In this way, full traceability is achieved, from requirements to design to implementation. Recent tool advances have provided bidirectional traceability in all cases, as well as the capability to generate summary reports, including a report summarizing all the requirements information contained within a model.

Simulation helps validate that requirements are being satisfied by enabling a design to be executed and easily exercised over a range of conditions. However, it is difficult to ensure that a set of simulations exercises a design over all conditions. To facilitate complete functional test case coverage, a complement to simulation is the use of formal analysis, or property proving to generate test cases. These techniques use mathematically rigorous procedures to simplify and search through a model's possible execution paths to find test cases and counterexamples. This systematic analysis provides deeper understanding of the behavior of designs.

For example, consider an aircraft engine thrust reverser that can be used to help the aircraft brake on short landing strips. Typically, reverser function is driven by logic, in software or hardware, which involves a number of sensor inputs, such as airspeed, weight on wheels, engine thrust, etc. Using property proving technology, an engineer can pose the question to the COTS tools—"Prove to me that this logic will never en-

gage if the airspeed is above a certain value or the weight is off the wheels." In this way, a developer can define these mission-critical properties, and formal analysis tools with model-based design can prove certain scenarios cannot happen under any conditions.

Verification

Verification is needed at each step of the process to ensure that an implementation matches the design and satisfies requirements. Using the executable models, developed as part of model-based design, engineers can continuously and systematically test their designs in simulation as part of the development process. An additional benefit of this continuous test and verification is that the design is developed with testability in mind. This ensures that the design can be tested both in simulations and on physical prototypes.

Another verification activity is to ensure that test cases reach 100 percent MCDC coverage. While functional tests are used to ensure that performance requirements are met, they often do not exercise 100 percent of the design. Achieving this can be a daunting task. Model-based design and COTS tools can help address this challenge through formal analysis. Automatic test-generation tools, such as Simulink Design Verifier, ensure 100 percent coverage of the design at the model level. Note that in the end, the testing must also be exercised on the generated C or HDL code. However, the test cases generated on the model can be reused in C- or HDL-level testing.

Formal verification methods can be used at the source code level, as well. New COTS tools, such as PolySpace products, employ formal methods called abstract interpretation. These tools can find, for example, divisions by zero and overflows. These errors have actually occurred in production and helped motivate the development of formal analysis tools. In one example, a booster rocket went off course and had to be destroyed. In the original test case, designers upgraded the engines with greater thrust, producing greater G loads. But in the control system, software was reused from a previous version of the rocket, which produced lower levels of acceleration. The result was an overflow causing a problem in the control logic.

Conformance to standards

The development of and adherence to design and coding styles is a key part of a safety-critical workflow. To aid engineering, model-based design tools provide a static check on the model and determine if it conforms to corporate or industry modeling standards. Modeling standards are equivalent to coding standards and can dictate aesthetic and functional aspects of the model. Model-based design provides this static check, meaning design engineers are not executing the model, but rather looking at it statically and analyzing its characteristics. Typical characteristics include: settings, data types, code generator settings, HDL settings, etc.

This static process can detect mistakes as simple as a missing connection for a block output or input. The method can also uncover more serious, but nuanced issues.

The actual implementation, C or HDL, must also conform to standards. Tools, such as PolySpace, can analyze C code to ensure it conforms to MISRA-C code standards.

On the HDL side, tools such as HDL Designer from Mentor Graphics provide HDL conformance checking capabilities. Conformance to design, code, and HDL standards is another objective that must be met for DO-178B and DO-254.

Tool qualification

A review is necessary after many stages of development and verification. Traditionally these reviews have been time-consuming manual processes, usually taking the form of design review sessions. However, the certification standards discussed here allow for verification tools to be qualified on a program-by-program basis. Tool qualification enables engineers to trust the output of the verification tool and skip manual reviews.

Today, engineers can use products such as The MathWorks DO Qualification Kit to qualify tools for use on their specific projects. With tool operational requirements, tool qualification plans, test case models, and code, the kit helps address the individual components of each standard's tool qualification requirements and produce the required evidence to demonstrate compliance.

Bill Potter and Matt Behr are involved in aerospace industry marketing at The MathWorks, a provider of software for technical computing and model-based design in Natick, Mass.

PRODUCT INTELLIGENCE

Multisensor designs and increasing resolutions are major trends in infrared and other electro-optical sensors

By **JOHN KELLER**

Infrared (IR) and other electro-optical sensors for aerospace and defense applications have come a long way in the past few decades, and over the next several years will see major technological breakthroughs in sensitivity, resolution, and overall ability to help military forces see through fog, smoke, dust, and the darkness of night.

The two most widely used electro-optical sensors for military and aerospace applications involve IR and light amplification. IR sensors, for example, primarily detect heat signatures, while light-amplification sensors—such as night-vision goggles—amplify available light thousands of times to make nighttime scenes look like daylight.

Infrared sensors, on the one hand, are making big improvements in resolution and in the ability to function reliably either without external cooling, or with less cooling than hitherto has been necessary.

Light-amplification sensors, on the other hand, continue to squeeze more performance out of conventional light-amplification tube technology, and to convert the sensor's analog signal to digital to align the technology for use in network-centric operations on the digital battlefield.

For both technologies, one trend is clear: the growing use of multispectral electro-optical sensing that blends inputs from several different sensors to capitalize on the best capabilities of each technology for a growing number of applications in handheld devices, as well as unmanned vehicles.

"We are seeing a trend to fused solutions, ranging from shortwave IR, plus longwave IR, as well as fusing light amplification and thermal imaging," explains Chris Wright, senior vice president of business development for the DRS Technologies RSTA group in Palm Bay, Fla., which specializes in IR sensors. RSTA stands for reconnaissance, surveillance, and target acquisition.

Combining the best aspects of several different electro-optical sensors has many advantages, but works best when the given sensor combination is suited to specific applications. Light-amplification sensors, for example, are good at watching broad areas at night, but might fall short in detecting a motionless person under cover of foliage. Combine this sensor with a longwave IR thermal imager, however, and the person standing still behind a bush will come out clearly. Better yet, include a shortwave IR sensor, and the facial features of the person behind the bush become recognizable.

The AN/PVS-14 ground-based soldier night-vision system from ITT uses advanced light-amplification technology to see in the dark.

Searching for heat sources with a longwave IR sensor, such as people, machinery, and vehicles, is a relatively easy trick, yet these sensors cannot see through windows in buildings and vehicles; to do that requires either a light-amplification sensor or shortwave IR. For challenges in seeing through fog, mist, dust, or smoke in daylight, shortwave IR often is the best solution.

"The soldier wants to have as complete situational awareness as possible, and he wants all the information he can," says Less Hodges, business development manager for U.S. government sales the ITT Geospatial Systems Night Vision and Imaging segment in Roanoke, Va., which specializes in light-amplification technologies for night-vision goggles and other night-vision optics.

"Based on DOD [U.S. Department of Defense] desires, the push for us is into multispectral sensing with two or more channels in a digital platform," Hodges says. "Visible light amplification, near-infrared, and thermal spectrum imaging are the ones getting the most fielding time."

As far as IR sensors are concerned, major trends in cooled and uncooled sensor technologies involve putting increasing numbers of pixels on sensing arrays. "In the cooled area, we are in the 10-micron pixel size, and are moving to five microns in about five years time," says DRS's Wright. "This can provide either twice as

COMPANY INFORMATION

Axsys Technologies, a division of General Dynamics
Rocky Hill, Conn.
www.axsys.com

BAE Systems Electronics, Intelligence & Support
Nashua, N.H.
www.eis.na.baesystems.com

DRS Technologies RSTA
Palm Bay, Fla.
www.drs.com

FLIR Systems Inc.
Wilsonville, Ore.
www.flir.com

Lockheed Martin Missiles and Fire Control
Orlando, Fla.
www.lockheedmartin.com

ITT Geospatial Systems Night Vision and Imaging
Roanoke, Va.
www.nightvision.com

ITT's Geospatial Systems
Rochester, N.Y.
www.ssd.itt.com

Kollsman, an Elbit Systems of America company
Merrimack, N.H.
www.kollsman.com

L-3 Infrared Products
Dallas
www.l-3com.com

OASYS Technology
Manchester, N.H.
www.oasys-technology.com

Premier Electronics Ltd
Hoddesdon, England
www.premierelect.co.uk

Princeton Lightwave
Cranbury, N.J.
www.princetonlightwave.com

Raytheon Vision Systems (RVS)
Goleta, Calif.
www.raytheon.com

Sagem
Paris
www.sagem-ds.com

Sensors Unlimited Inc.
Princeton, N.J.
www.sensorsinc.com

Sofradir
Chatenay-Malabry, France
www.sofradir.com

Stanford Photonics Inc.
Palo Alto, Calif.
www.stanfordphotonics.com

This image shows how blending light-amplification and longwave infrared sensor technologies might detect a person hiding in the dark.

many pixels in the same detector for enhanced resolution, or the same number of pixels in a smaller detector."

In light amplification, experts are making incremental improvements in tube technology such that the blooming from ambient light sources that once was the bane of night-vision goggles has virtually disappeared, says ITT's Hodges.

Driving these technological improvements are a growing number of aerospace and defense applications that require ever-smaller sensors with ever-more capability, such as handheld sensors, and tiny sensor payloads for unmanned aerial vehicles (UAVs).

"You read about the drones in Afghanistan and Pakistan, but at all levels, you're seeing airborne platforms in a variety of sizes really taking off in terms of how many are being used and the capabilities they have," says David Strong, vice president of market for the government systems division of FLIR Systems Inc. in Wilsonville, Ore. "One of the key factors are the sizes of sensors that can go onto UAV platforms of various sizes, from the Predator and even to the hand-launched kinds of UAVs that are being used in great numbers now," Strong says. "A great deal of work in technology development is to have multisensor packages for a variety of applications."

ELECTRO-OPTICS WATCH

Glitter-sized photovoltaics may turn hats, shirts, and pants into power-producing solar cells

By **JOHN McHALE**

ALBUQUERQUE, N.M.—Sandia National Laboratories scientists in Albuquerque, N.M., have developed tiny glitter-sized photovoltaic cells that could turn a person into a walking solar battery charger if the person were fastened to flexible substrates molded into clothing to enable warfighters to recharge their batteries as they move.

The solar particles, fabricated of crystalline silicon, hold the potential for a variety of new applications, Sandia scientists say. They are expected eventually to be less expensive and have greater efficiencies than current photovoltaic collectors that are pieced together with 6-square-inch solar wafers.

The cells are fabricated using microelectronic and microelectromechanical systems (MEMS) techniques common to today's electronic foundries.

Sandia lead investigator Greg Nielson says the research team has identified more

Magnified photovoltaic cells look like glitter, and could turn a person into a walking solar battery.

DHS seeks enhanced imaging technology for non-intrusive inspection of shipping containers

FORT HUACHUCA, Ariz.—The U.S. Department of Homeland Security (DHS) in Washington has asked industry to submit proposals for new kinds of non-intrusive inspection technologies to enable DHS Customs and Border Protection agents to inspect cargo containers on trucks, ships, trains, and aircraft for dangerous contraband without opening the containers.

The intent is to develop and deploy imaging technology with better penetration, resolution, contrast sensitivity, throughput, and automated material identification capability than is available today that will enable a detailed inspection of vehicles as well as interiors of large cargo and air shipping containers.

This DHS project is called CanScan, which seeks to improve on existing X-ray and gamma-ray technologies that Customs and Border Protection agents use to inspect incoming shipping containers.

The U.S. Department of the Interior's National Business Center at Fort Huachuca, Ariz., issued the CanScan broad agency announcement (BAA 10-CANSCAN) last month on behalf of the DHS Science and Technology Directorate. The BAA involves non-intrusive inspection and automated threat recognition technologies.

International terrorists and smugglers may use hidden compartments or other ways to hid contraband across the U.S. border, DHS officials say. To counter this, DHS wants improved non-intrusive detection systems to enhance screening, examination, and detection of contraband, hidden compartments, materials for weapons of mass destruction, and human stowaways.

Infrared search and track system for Navy F/A-18 jet fighter enters full-scale development

The Boeing Co. in St. Louis is beginning full-scale development of the infrared search and track (IRST) sensor system for the U.S. Navy F/A-18 Hornet jet fighter-bomber, which will enable the Hornet to detect and track enemy aircraft at long ranges without the use of onboard radar systems. The F/A-18 E/F IRST is a passive, longwave infrared heat-seeking

sensor system that searches for, detects, and tracks enemy aircraft at long ranges, even in the presence of electronic jamming that might disrupt radar systems. Officials of the U.S. Naval Air Systems Command (NAVAIR) at Patuxent River Naval Air Station, Md., announced their intention in January to award a contract to Boeing to test and integrate the IRST into the F/A-18 E/F block II aircraft. This contract formally moves the F/A-18's IRST system into the engineering and manufacturing development (EMD) phase. The Lockheed Martin Corp. Missiles and Fire Control segment in Dallas is under subcontract to build the F/A-18's IRST system for Boeing, which is the prime contractor for the Hornet aircraft. Engineering and manufacturing development, which military officials used to call full-scale development, is the last step before full production. Navy leaders expect to start fielding the IRST on Hornet jets by 2012. The beauty of the IRST is its ability to conceal its presence from enemy sensors, unlike radar systems that emit detectable RF energy that not only can give away its presence, but also provide a target for anti-radiation missiles. The IRST also is immune to electronic jamming. Information from the IRST can stand alone or be fused with other sensor data to enhance situational awareness to help F/A-18 pilots with first-look, first-shoot capability. The IRST also provides the F/A-18E/F mission computer with track file data on all targets as well as infrared imagery.

than 20 benefits of scale for its microphotovoltaic cells—including new applications, improved performance, potential for reduced costs, and higher efficiencies.

"Eventually units could be mass-produced and wrapped around unusual shapes for building-integrated solar, tents, and maybe even clothing," he says. This would make it possible for hunters, hikers, or military personnel in the field to recharge batteries for phones, cameras, and other electronic devices as they walk or rest.

Such microengineered panels could have circuits imprinted that would help perform other functions customarily left to large-scale construction with its attendant need for field construction design and permits.

"Photovoltaic modules made from these microsized cells for the rooftops of homes and warehouses could have intelligent controls, inverters, and even storage built in at the chip level," says Vipin Gupta, Sandia field engineer. Such an integrated module could greatly simplify the cumbersome design, bid, permit and grid integration process that our solar technical assistance teams see in the field all the time."

For large-scale power generation, "one of the biggest scale benefits is a significant reduction in manufacturing and installation costs compared with current PV techniques," says Sandia researcher Murat Okandan.

Part of the potential cost reduction comes about because microcells require relatively little material to form well-controlled and efficient devices. From 14 to 20 micrometers thick (a human hair is about 70 micrometers thick), they are 10 times thinner than conventional 6-inch-by-6-inch brick-sized cells, yet perform at about the same efficiency.

"So they use 100 times less silicon to generate the same amount of electricity," Okandan says. "Since they are much smaller and have fewer mechanical deformations for a given environment than the conventional cells, they may also be more reliable over the long term."

Another manufacturing convenience involves the tiny sizes of the cells; they are only hundreds of micrometers in diameter, can be fabricated from commercial wafers of any size, including today's 12-inch wafers and future 18-inch wafers. Further, if one cell proves defective in manufacture, the rest still can be harvested, while if a brick-sized unit goes bad, the entire wafer may be unusable.

Brick-sized units fabricated in larger than 6-inch-by-6-inch technology also would require thicker power lines to harvest power, creating more cost and possibly shading the wafer. That problem does not exist with the small-cell approach and its individualized wiring.

Other unique features are available because the cells are so small. "The shade tolerance of our units to overhead obstructions is better than conventional PV panels," Nielson says, "because portions of our units not in shade will keep sending out electricity where a partially shaded conventional panel may turn off entirely."

Because flexible substrates can be easily fabricated, high-efficiency PV for ubiquitous solar power becomes more feasible, Okandan says. Electricity can be harvested from the Sandia-created cells with 14.9 percent efficiency. Off-the-shelf commercial modules range from 13 to 20 percent efficient.

Other possible applications for the technology include satellites and remote sensing.

The project combines expertise from Sandia's Microsystems Center; Photovoltaics and Grid Integration Group; the Materials, Devices, and Energy Technologies Group; and the National Renewable Energy Lab's Concentrating Photovoltaics Group. The work is supported by the Department of Energy's (DOE's) Solar Energy Technology Program and Sandia's Laboratory Directed Research & Development program, and has been presented at four technical conferences this year.

Extreme-field-of-view surveillance imaging technology is goal of DARPA FDOS program

By **JOHN KELLER**

ARLINGTON, Va.—Electro-optics scientists at the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., are asking industry to develop advanced high-resolution 3D imaging technology with dramatically wide field of view and depth of field in reconnaissance and surveillance applications.

The program is called Fine Detail Optical Surveillance (FDOS), and seeks to develop a fundamentally new battlefield optical intelligence, surveillance, and reconnaissance (ISR) capability for infantry soldiers and unmanned aerial vehicles (UAVs) that can provide ultra-high-resolution 3D images to help identify targets in hostile environments.

In essence, the program seeks to develop technology able to image and identify "a needle moving along the surface of a haystack," without the need to scan or focus the optical receiver, DARPA officials say. DARPA scientists want the ability to image a variety of surfaces and complexities under turbulent conditions.

The FDOS program will develop several different prototype systems able to provide imagery of moving targets at several different ranges and resolutions.

Current optical imaging systems that can provide high angular resolution are designed and optimized for tactical targets such as infrastructure, buildings, and vehicles, DARPA officials explain. These systems have limited applications as they are physically large and can only image a small volume of space without retargeting or refocusing the receiver optics.

The fields of view of these conventional systems are defined by the optical components, with the complexity of the design scaling exponentially with aperture size, while the dept of field is defined by the required target resolution, DARPA officials say. For 3D imaging systems, an additional constraint is in the complexity of the illumination system required to obtain the range measurement.

These constraints cannot be overcome by current system designs and are impractical for portable, small-scale operations, DARPA points out. Transforming existing optical system technology will require a departure from the traditional lens-based imaging approach to one that uses recent advances in focal-plane arrays, laser technology, and image-processing algorithms.

The FDOS program will develop systems small enough for portable operations, with depth of field and field of view large enough eliminate the need for steering or focusing to obtain high-resolution imagery.

ENABLING PERFORMANCE BASED OPERATIONS

avionics europe
Incorporating Defence Electronics

Conference and Exhibition
24th–25th March 2010
Passenger Terminal (City Centre)
Amsterdam, The Netherlands
www.avionics-event.com

EXPLORE NEW FRONTIERS

Your invitation to the leading event for global commercial and defence avionics and defence electronics

International competition has intensified during a challenging economic atmosphere as companies and governments look to keep pace with next-generation avionics and air traffic management capabilities.

AVIONICS CONFERENCE TRACK INCLUDES:

- Avionics With ATM
- Performance Based Operations
- Regulatory Frameworks for Avionics
- Next Generation Military Avionics

DEFENCE ELECTRONICS CONFERENCE TRACK INCLUDES:

- COTS Integration Challenge
- Thermal Management
- Trusted COTS
- Software Defined Radio In Defence Applications

Exhibition Times
Wed 24th March: 10:00am – 6:00pm
Thurs 25th March: 10:00am – 4:30pm

Opening Keynote
Open and FREE of charge to all
Wed 24th March: 9:00am – 10:00am

Networking Reception
Wed 24th March: 5:30pm – 7:30pm

Exhibitor Presentations
Open and FREE of charge to all throughout the exhibition opening hours

REGISTER ONLINE AT WWW.AVIONICS-EVENT.COM

PLEASE USE THIS PROMOTIONAL CODE WHEN REGISTERING: MAE-0210

If you are involved in the aviation electronics and defence electronics market, you cannot afford to miss Avionics Europe incorporating Defence Electronics.

For full conference programme or to register online visit www.avionics-event.com




Co-located with: NEAR SPACE SECURITY
Flagship Media Sponsors: avionics, Military & Aerospace Electronics
Owned & Produced by: PennWell
Sponsors: WIND RIVER, LYNUXWORKS, STRATEGYANALYTICS
Supporting Organisation: n4c, ADS, NIDV DEFENSIE & VEILIGHEID, AIRBUS, IET

PRODUCT APPLICATIONS

RUGGED DISPLAYS

Vetronics upgrade for M109A6-PIM self-propelled field artillery uses rugged displays from RGB Spectrum

Armored vehicle designers at BAE Systems Ground Systems Division in York, Pa., needed integrated rugged displays for vetronics upgrades on the M109A6 Paladin Integrated Management (PIM) self-propelled heavy artillery combat vehicle. They found their solution from RGB Spectrum in Alameda, Calif.

RGB is providing its QuadView XLRT multiviewer multi-data point integrated display for the M109A6-PIM vetronics to enhance the crew's situational awareness, and to give commanders a more comprehensive battlefield picture for decision making.

The M109A6-PIM uses the existing Paladin artillery main armament and cab structure, yet replaces hydraulics with electric gun drives. Outmoded chassis components are replaced with up-to-date components and integrated into a new chassis structure to increase sustainability and commonality across the U.S. Army's Heavy Brigade Combat Teams (HBCT).

The QuadView XLRT multiviewer is the core component in the vehicle's display system, and shows mission-critical data from a combination of computer and video signals onto a centralized screen, RGB officials say. Video inputs include surveillance and reconnaissance video cameras from land vehicles and unmanned aircraft.

Computer sources include maps, topography, battlefield sensors, force tracking and resources databases, satellite down-linked surveillance, and fire control systems. The multiviewer consolidates these sources and outputs four selected images at a time to an Aydin Displays 52-inch liquid crystal display with 1920-by-1080-pixel resolution, RGB officials say.

The QuadView processor enables the vehicle commander to display information according to his preferences in as many as four window arrangements or a full screen. The commander can manipulate each window to be any size, anywhere, providing a limitless combination of display configurations, RGB officials say.

Operators can select input sources, manipulate images, and choose from pre-set window display arrangements. Images can also be zoomed and panned to concentrate on a particular area of interest.

"The QuadView display system delivered exactly what the U.S. Army's Heavy Brigade Combat Teams needed and asked for," says Bob Opsitos, lead engineer for BAE Systems on the M109A6-PIM project, which seeks to sustain the Army's Paladin fleet into 2050. "It is an excellent solution for the most demanding mission-critical applications where multiple visuals and data need to be presented in a unified way."

For more information, visit RGB Spectrum online at www.rgb.com, or BAE Systems Ground Systems Division at www.baesystems.com.

POWER ELECTRONICS

Falcon Electric finishes deliveries of rugged power system for Army Humvee shelter applications

Defense contractor Sechan Electronics Inc. of Lititz, Pa. needed rugged uninterruptible power supplies (UPS) for a U.S. Army shelter system mounted on a Humvee tactical vehicle. They found their solution in the ED Series UVS Plus lightweight, 5-kilovolt-ampere (kVA), three-phase power conversion system with lightweight battery pack from Falcon Electric Inc. in Irwindale, Calif.

Falcon Electric has finished shipping the company's ED Series UVS Plus power conversion system to Sechan, which is providing the Humvee-shelterized system to the Army. The ED Series power-conversion system was designed and tested to U.S. Department of Transportation (DOT) standards and other certifications.

"Shelter systems are one of Sechan's many areas of expertise," says Kraig Wickard, an electrical engineer at Sechan. "Falcon Electric was willing to design a unit for our specific needs. We needed a three-phase to 120-volt AC, 60 Hz single-phase UPS solution to power the onboard computers and communications equipment."

POWER STORAGE

Navy to power unmanned underwater vehicles with fuel cell stack technology from Delphi

U.S. Navy undersea technology researchers needed a 30-cell, solid-oxide fuel cell stack (SOFC) system to power unmanned underwater vehicle (UUV) applications. They found their solution from Delphi Corp. in Troy, Mich.

The Naval Undersea Warfare Center Division, Newport (NUWCDIVNPT) in Newport, R.I. is awarding a sole-source contract to Delphi to provide the 30-cell SOFC fuel cell system. A fuel cell is an electrochemical cell that produces electricity from a fuel tank by producing a reaction between the fuel and an oxidant. Fuel cells can operate virtually continuously as long as the necessary flows are maintained.

The Navy is awarding the contract to Delphi sole source because researchers find that solid-oxide fuel cell stack technologies from other companies have shown either unacceptable levels of gas leakage, lower power density, or too high an operating temperature, Navy officials say.

Delphi experts will supply the 30-cell, solid-oxide fuel cell stack, set-up and initiate fuel processor testing, and do post run autopsy and analysis of the stack.

For more information, visit the Naval Undersea Warfare Center online at www.navsea.navy.mil/nuwc/newport/, or Delphi Corp. at http://delphi.com.

AVIONICS

Boeing B-52 upgraded with CONECT system makes first test flight

The U.S. Air Force needed give B-52 bomber crews the ability to receive and send real-time digital information during their missions. They found their solution in the Combat Network Communications Technology (CONECT) from the Boeing Co.

Boeing says a B-52H jet bomber upgraded with CONNECT communication technology completed its first test flight at Edwards Air Force Base, Calif. The more than three-hour flight included an initial system build-up test, interphone test, and communication test. The test process included power-on of each system in flight

PRODUCT APPLICATIONS

to determine that there were no adverse effects on flight-essential systems.

"Completion of the first test flight brings us one step closer to giving command centers and troops on the ground the ability to communicate with the B-52 through the military's digital information network," says Jim Kroening, Boeing B-52 development programs manager. "Augmenting current voice-based communication gives B-52 crews greater situational awareness and significantly enhanced mission capabilities."

Boeing and the U.S. Air Force have accomplished more than 220 ground test points out of about 500. Following ground and flight tests, the aircraft will rotate through its planned depot maintenance at Tinker Air Force Base, Okla., and resume ground and flight tests in January 2011 at Edwards.

RF AND MICROWAVE

Herley wins contract to provide microwave assemblies for Navy P-8A aircraft electronics

U.S. Navy officials needed integrated microwave assemblies for the P-8A maritime patrol jet aircraft. They found their solution from Herley Industries Inc.'s New England division in Lancaster, Pa.

Herley won a $1.5 million contract to deliver microwave assemblies for the P-8A, the U.S. Navy's newest maritime patrol and reconnaissance aircraft. It is a long-range, anti-submarine warfare, anti-surface warfare, intelligence, surveillance, and reconnaissance aircraft capable of broad-area, maritime, and littoral operations, explains a representative.

Richard F. Poirier, Herley's CEO and president, comments: "This is Herley's first production award for the P-8A program, following the completion of the development phase. We are pleased to be a part of this important U.S. Navy program, and anticipate receiving follow-on contracts from the prime contractor on this program over the next 15 years."

MISSILE GUIDANCE

Draper Lab to extend life of Trident II submarine-launched ballistic missile guidance system

U.S. Navy leaders needed upgrades to the missile guidance systems of the U.S. Navy Trident II (D5) submarine-launched ballistic missile. They found their needed solution from the Charles Stark Draper Laboratory

Inc. located in Cambridge, Mass.

Draper Lab experts will upgrade the Trident D5 missile guidance system under terms of a $131.1 million contract awarded last month.

Draper Lab scientists are buying long-lead materials and circuit card assemblies for 20 MK6LE guidance systems for the Trident II (D5) atomic missile. The contract is part of the Trident II (D5) MK6 life extension guidance system.

Work will be in Bloomington, Minn.; Clearwater, Fla.; Cambridge, Mass.; and Pittsfield, Mass. Awarding the contract were officials of the U.S. Strategic Systems Programs, Arlington, Va.

POWER ELECTRONICS

Lockheed Martin selects Protonex to enhance HULC exoskeleton power supply

Lockheed Martin in Orlando, Fla., selected Protonex Technology Corp. to develop power supply concepts that will enable the HULC robotic exoskeleton to support missions for more than 72 hours.

Protonex will evaluate fuel cell-based power solutions that can be carried by the HULC, while at the same time powering the exoskeleton and the user's mission equipment during extended dismounted operations.

"Integrating state-of-the-art power technology on the HULC is a whole system approach to meeting the needs of dismounted warfighters and special operations forces," says Rich Russell, director of Sensors, Data Links and Advanced Programs at Lockheed Martin Missiles and Fire Control. "With proper power-management systems, the HULC can be used to recharge critical equipment while carrying heavy combat loads on an extended mission."

Lockheed Martin's un-tethered HULC exoskeleton is an anthropomorphic, electro-hydraulic design that currently operates on lithium-polymer batteries. An on-board micro-computer senses the user's actions and ensures the exoskeleton moves in concert with the operator. The HULC design maintains combat flexibility, allowing deep squats, crawls, and upper-body lifting with minimal human exertion.

Dismounted soldiers often carry loads greater than 130 pounds, including electronics and numerous extra batteries needed to operate gear and complete 72-plus-hour operations in the field. The HULC, equipped with an extended-mission power supply with recharge capability, would enable dismounted soldiers on these missions to carry fewer batteries.

Protonex develops and manufactures compact, lightweight, and high-performance fuel cell systems for portable power applications in the 100- to 1000-watt range. The company's fuel cell systems are designed to meet the needs of military, commercial and consumer customers for off-grid applications by providing customizable, stand-alone portable power solutions.

SENSORS

QinetiQ North America developing roving, early-warning WMD detector for U.S. Army

U.S. Army researchers needed an autonomous, self-deploying sensor that will serve as a roving, early-warning detector of biological warfare activity in weapons of mass destruction (WMD). They found their solution from QinetiQ North America in McLean, Va., which is working with Brewer Science and Applied Systems Intelligence.

Work on the project will be performed primarily at the Jordan Valley Innovation Center (JVIC) at Missouri State University, Springfield, Mo., and the Waltham, Mass., office of QinetiQ North America's Technology Solutions Group. All three companies involved in the project are members of JVIC.

Dr. Ryan Giedd, the executive director of JVIC, says: "The development of this mobile, early-warning robot sensor in Springfield is a great opportunity for Missouri State, its students, and our community. JVIC has now progressed to the point where we are value-adding to the most sophisticated of advanced technologies known while providing job opportunities in the near future for advanced manufacturing."

The program is designed to meet a stated Department of Defense need for a tactical chemical and biological defense, as well as an intelligent network that can communicate and direct sensors so they provide real-time notice of a threat.

Brewer Science, in Rolla, Mo., will provide biological agent sensor elements based on carbon nanotechnology. Applied Systems Intelligence (ASI), in Alpharetta, Ga., will develop software to integrate sensing, detection, identification, and alerts for the system. QinetiQ North America will be responsible for building and qualifying the detector, integrating the systems, and testing the sensor.

"This project will help create a new and advanced chemical and biological threat-detection capability for the military and for homeland defense," says J.D. Crouch, president of the QinetiQ North America's Technology Solutions Group.

EMBEDDED COMPUTING

L-3 MAPPS chooses computer boards from GE for naval electrical, damage, and machinery control

Control and simulation specialist L-3 MAPPS in Quebec City needed computer boards for the company's marine systems and simulation applications in naval electrical, damage, and machinery control. They found their solution in the Intel Pentium-based VME7667 computer board from GE Intelligent Platforms in Charlottesville, Va.

The single-board computer order for GE from L-3 MAPPS is for $750,000, GE officials say. L-3 engineers will use the VME7667 to handle digital I/O systems, as well as managing data for graphic user interfaces (GUIs). The VME7667 is a version of the GE V7807 embedded computer customized for L-3 MAPPS, and will be a drop-in replacement for a previous CPU board, which L-3 engineers designed in-house.

The V7807 on which the VME7667 is based is a 6U VMEbus embedded computing module featuring Intel Pentium M processor, 1.5 gigabytes of memory, dual Gigabit Ethernet ports, and a PMC expansion site. It has four serial ports, four USB 2.0 ports, and serial ATA and IDE interfaces.

L-3 MAPPS is supplying its Integrated Platform Management System (IPMS) for the upgrade and modernization of Canada's Halifax-class frigates to help handle damage control, electrical control, and machinery control, as well as link sensors and computers to the vessel's command and control system. All 12 of Canada's Halifax frigates are to be upgraded by 2017.

For more, visit GE at www.ge-ip.com, or L-3 MAPPS at www.mapps.l-3com.com.

CORE i7 PRODUCTS

To submit new products for consideration, contact John Keller by e-mail at jkeller@pennwell.com

Intel i7-based computer boards for military, industrial, and telecom applications introduced by Advantech

Advantech Co. Ltd. in Irvine, Calif., is introducing embedded boards based on the Intel Core i7 processor, ranging from computer-on-modules and single-board computers to industrial motherboards for multi-tasking and digital media solutions in military, factory automation, telecommunications, medical, and casino gaming applications. Advantech also is releasing four other industrial motherboard embedded computer products based on Intel's Core i7 processor: the Mini-ITX motherboard AIMB-280, MicroATX motherboard AIMB-580, ATX motherboard AIMB-780, and the PICMG 1.3 SBC PCE-5125. The company's COM-Express SOM-5788 is for graphic intensive and dual-display applications. Advantech provides embedded software support for these boards consisting of Windows 7, XPe, and Linux. Advantech's software APIs (SUSI) are bundled with Advantech boards. For more information, visit Advantech online at www.advantech.com.

Rugged 6U VME and CompactPCI computer boards based on Intel Core i7 processor introduced by GE

GE Intelligent Platforms today announced three rugged VME and CompactPCI computer boards based on Intel Core i7 processor operating as fast as 2.53 GHz—

the 6U VME VR12, 6U CompactPCI CR12, and the 6U VME XVB601—for demanding applications such as radar processing and flight control as well as in general purpose industrial and commercial system-level applications. GE also announced plans to introduce rugged 6U VPX and rugged 3U VPX single-board computer products based on Intel Core i7 processing technology. The VR12 and CR12 embedded computers have two XMC expansion sites in one slot for I/O, communications, and other capabilities. The boards can support as much as 8 gigabytes of DDR3 SDRAM memory with ECC. The Intel Core i7 is based on a 32 nanometer manufacturing process to enhance performance without compromising power consumption and heat dissipation. Its memory controller delivers low latency and high memory bandwidth for data-intensive applications, and its graphics processor makes the chipset more compact, increases throughput, and frees board space. Connectivity includes two front Gigabit Ethernet ports, two Gigabit Ethernet ports, VGA, five USB ports, two DVI ports, three SATA ports, and two COM ports. It is available in five ruggedization levels, from benign/office to rugged convection cooled. The CR12 is identical in specification to the VR12, except that it is a CompactPCI single-board computer. For more information, visit GE Intelligent Platforms online at www.ge-ip.com.

6U VME single-board computer based on Intel Core i7 processor introduced by Curtiss-Wright

Curtiss-Wright Controls Embedded Computing in Leesburg, Va., is introducing a high performance VME64x digital signal processing (DSP) computer board called the CHAMP-AV5 that uses the Intel Core i7-610E processor for low-power, high-performance solutions in demanding military signal processing applications. The CHAMP-AV5 embedded computer complements the Curtiss-Wright Controls SVME/DMV-1905 single-board computer, also based on the Intel Core i7 processor, which also is for rugged deployed COTS signal processing applications. The CHAMP-AV5 multi-processing CPU board brings the floating-point performance of the Intel

Core i7 architecture to VME64x. It has a pair of 2.53 GHz dual-core Core i7 processors for performance as fast as 81 billion floating point operations per second. With a 17-gigabyte-per-second (peak) DDR3 memory subsystem connected directly to the processor. The board also has 4 megabytes of cache and two hardware threads per core, is pin-compatible with the Curtiss-Wright MPC7447/7448-based CHAMP-AV4, and has a high-bandwidth PCI Express architecture, with on-board connections between the processors and the PMC/XMC sites. "The combination of Intel Core i7 processor performance, along with Intel's commitment to long life-cycle supply, has propelled us to choose Intel as the best technology choice for our signal processing product line," says Lynn Patterson, vice president and general manager of Curtiss-Wright Controls Embedded Computing. "New embedded Intel processors are for advanced signal processing systems and the rugged deployed aerospace and defense market segment," says Ryan Parker, director of marketing at the Intel Embedded and Communications Group. For more information, visit Curtiss-Wright online at www.cwcembedded.com.

Emerson Network Power launches embedded computing platforms with latest Intel Core processors

Emerson Network Power, a business of Emerson, has released three new embedded computing platforms powered by the latest Intel Core i7 and Intel Core i5 processors from Intel. These new embedded computing platforms are available in a range of form factors, including COM Express, MicroATX, and 6U VME for medical

and military/aerospace applications. The Intel Core i7 and Intel Core i5 processors use next-generation 32 nanometer manufacturing process technology, providing system integrators with increases in performance and energy efficiency. Based on the Type 6 COM Express R2.0 form factor (95 by 125 mm), the COMX-CORE-7X0 and COMX-CORE-5X0 feature Intel Core i7 processor 2.0 GHz and 1.06 GHz variants or the Intel Core i5 processor at 2.4 GHz and the mobile Intel QM57 Express chipset. Two SO-DIMM (non-ECC) sockets can accommodate up to 8GB DDR3 memory and an optional eUSB flash module extends on-module storage. Connectivity includes one PCI Express x16 and seven PCI Express x1 expansion sockets, one Gigabit Ethernet, and four SATA and eight USB 2.0 ports. Emerson Network Power's new COM Express modules support dual simultaneous displays without the need for an additional graphics card. This next-generation Emerson Network Power MicroATX motherboard (244 by 244 mm) features Intel Core i7 processor variants up to 2.66 GHz, the mobile Intel QM57 Express chipset, and two SO-DIMM sockets for up to 8GB DDR3 memory. Connectivity includes one PCI Express x16, three PCI Express x1 expansion sockets, and a PCI Express Mini Card socket for WiFi/WiMAX wireless connections. For more information, visit Emerson Network Power online at www.emerson.com.

Seven CPU boards based on Intel Core i7 introduced by Extreme Engineering Solutions

Extreme Engineering Solutions Inc. (X-ES) in Middleton, Wis., is part of the parade of new embedded computing products based on the Intel Core i7 microprocessor with its announcement of seven computer boards based on Intel's newest processor chip. X-ES officials are offering four Core i7-based single-board computer products immediately in the XMC, 3U VPX, 6U VPX, and VME form factors, and in March will add three CPU board offerings in 3U CompactPCI, 6U CompactPCI,

and Processor PCI Mezzanine Card (PrPMC) form factors with the Core i7 chip. All of X-ES's computer board products based on the Intel Core i7 embedded processor are available in commercial air-cooled and rugged, conduction-cooled versions for military, industrial, and commercial applications. The Intel Core i7 processor represents the next step in fast, multi-core technology, X-ES officials say. Intel's fundamental architectural change implemented in the Intel Core i7 processor offers 32-nanometer manufacturing, improved performance-per-Watt, integrated DDR3 ECC dual-channel memory, and high-performance graphics controllers. X-ES is coupling the Core i7 processor technology with the Intel QM57 Express chipset, a low-power interface controller that offers integrated PCI Express, USB, SATA 3.0 gigabits per second, and graphics interfaces. "The Intel Core i7 processor represents a breakthrough in embedded performance per Watt," says Ben Klam, vice president of engineering at X-ES. "Because of the processing density that can be achieved, this processor will have a significant influence on how embedded systems are designed by allowing systems to be packaged into smaller spaces or allowing more to be done within the same space." For more information, visit X-ES online at www.xes-inc.com.

ADLINK introduces embedded computing module based on Intel Core i7/i5 processor

ADLINK Technology Inc. in San Jose, Calif., is introducing the Express-CB embedded computer on module with the 64-bit Intel Core i7/i5 processor for industrial automation, transportation, data storage, medical diagnostic equipment, medical imaging, portable medical devices, and instrumentation. The computer board is for systems integrators who need powerful processing and graphics performance in a product with that lasts for a long time. The CPU board module's Intel Core i7/i5 processor has CPU, memory controller, and graphics processor on the same chip, and is based on the Mobile Intel QM57 Express chipset. Integrated graphics support includes OpenGL 2.1, DirectX10, and Intel dynamic video memory technology (Intel DVMT 5.0). Graphics outputs include CRT, LVDS and Embedded DisplayPort. These computer boards support Intel Hyper-threading Technology (2 cores, 4 threads) and as much as 8 gigabytes of DDR3 dual-channel memory at 1066 MHz. The Express-CB has dual stacked SODIMM sockets. The Intel Mobile QM57 Express chipset integrates CRT and single/dual-channel 18/24-bit LVDS display output. A multiplexed PCI Express Graphics x16 (PEG x16) bus is available for discrete graphics expansion, Embedded DisplayPort, or general purpose x8, x4 or x1 PCI Express connectivity. For more information, visit ADLINK online at www.adlinktech.com.

Rugged 6U CompactPCI computer boards for mil apps based on Intel Core i7 introduced by Concurrent

Concurrent Technologies in Woburn, Mass., is introducing the PP 712/08x family of 6U CompactPCI computer boards based on the Intel Core i7 microprocessor for military, homeland security, and telecommunications applications. The computer board comes with a choice of processors among the 2.53 GHz Intel Core i7-610E, 2.0 GHz Intel Core i7-620LE, and the 1.06 GHz Intel Core i7-620UE. The Core i7 is based on 32-nanometer process technology and the Intel integrated memory/graphics controller architecture. The PP 712/08x single-board computer can optionally support extended temperatures ranging from -40 to 85 degrees Celsius. With as much as 8 gigabytes of DDR3-1066 ECC SDRAM, dual PMC/XMC sites, three Gigabit

Continued on page 46

NEW PRODUCTS

To submit new products for consideration, contact John Keller by e-mail at jkeller@pennwell.com

GRAPHICS PROCESSING

Nvidia-based graphics processor for harsh environments introduced by GE

GE Intelligent Platforms in Charlottesville, Va., is introducing the rugged XMCGA6 graphics processor Express Mezzanine Card (XMC) for applications in harsh

environments. The XMCGA6 graphics board uses either the Nvidia G72 or G73 graphics processing unit (GPU), developed originally for high-end consumer gaming, and builds on the relationship between GE and Nvidia Corp. The XMCGA6 embedded graphics module supports 8-lane PCI Express to communicate with a host single-board computer. It also can adapt automatically to 4-lane PCI Express, and has as much as 256 megabytes of GDDR3 memory (G73). Dual, independent channels enable the XMCGA6 to drive RGB analog component video and digital DVI 1.0 at maximum resolutions of 1,600 by 1,200 pixels. The XMCGA6's video input capability allows integration of sensor data using RS170, NTSC, or PAL video formats. For more information, visit online at www.ge-ip.com.

POWER ELECTRONICS

Rugged UPS for aerospace and defense applications introduced by Acumentrics

Acumentrics Corp. in Westwood, Mass., is introducing the ACB625R-36B 1U rugged uninterruptible power supply (UPS) that provides 500 watts of power and weighs 42 pounds. The rugged UPS has a replaceable battery and provides 15 minutes of backup power at full load (500 watts). It accepts input power of 80 to 265 volts AC at 47 to 63 Hz, and can be deployed worldwide with conventional and generator power. Packaging protects internal components from dirt, debris, rain, humidity, and other potential contaminants as required by MIL-STD-810F. For more information, visit Acumentrics online at www.acumentrics.com.

DATA BUSES AND NETWORKING

Development kits for MIL-STD-1553 data bus remote terminals introduced by Holt

Holt Integrated Circuits Inc. in Mission Viejo, Calif., is introducing development kits for the company's HI-6120 and HI-6121 MIL-STD-1553 remote terminal technology, which are single-chip, 3.3-volt devices with dual transceivers and 64 kilobytes of RAM, in surface-mount plastic packages. Each MIL-STD-1553 data bus device has its own kit and provides the user with a reference design board, power supply, USB cable, and CD containing software and a user's guide. The devices interface to an on-board Zilog ZNEOTM microprocessor which can be programmed over a USB using the supplied cable. The board also includes two external flash EEPROM devices for optional automatic initialization and bus interface transformers for connection to a MIL-STD-1553 bus. The HI-6120 uses a 16-bit parallel host bus interface in a 100-pin PQFP package, while the HI-6121 uses a 4-wire serial peripheral host interface (SPI) and comes in a 52-pin PQFP or 64-pin QFN. Included software demonstrates features of the devices, including auto-initialization, descriptor table setup, message illegalization, mode code handling, data buffering, and interrupt management. For more information, visit Holt Integrated Circuits online at www.holtic.com.

POWER ELECTRONICS

Rugged power supply for radio communications and RF power introduced by TDK-Lambda

TDK-Lambda Americas Inc. in San Diego is introducing the RFE1000 1-kilowatt, single-output AC-DC power supply series in a 1.61-inch high 1U

package for stand-alone or distributed power architectures in applications such as radio communications, factory automation, test and measurement, robotics, and RF power amplifiers. These power converter devices are for power electronics applications requiring reliable 24-, 32-, or 48-volt bulk power. Voltage adjustment as wide as +20 percent and -10 percent is possible. The device operates from a universal input of 85 to 265 volts AC with PFC, with efficiency as high as 88 percent. Power system designers can use the RFE1000 power supplies individually, or connect as many as eight units in parallel to form an N+1 redundant power system with built-in O-ring diodes. Each power supply has variable-speed cooling fans and can operate in temperatures ranging from 0 to 70 degrees Celsius. The RFE1000 has a power density of 10.5 watts per cubic inch, and measures 12 by 5 by 1.61 inches. Overvoltage, overcurrent, and over-temperature protection are standard. System monitoring features include opto-isolated signals for DC-OK, AC-fail, and over-temperature warnings, along with an LED indicator for DC-OK. For more information, visit TDK-Lambda online at http://us.tdk-lambda.com.

COMPONENTS

Aeroflex Colorado Springs unveils UT7R2XLR816 clock network manager

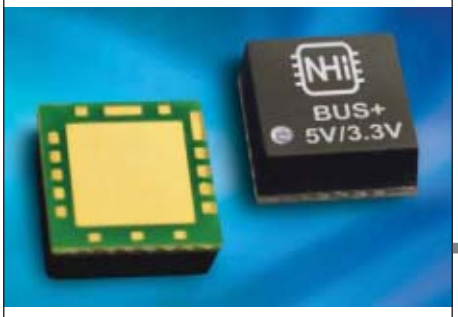
Aeroflex Colorado Springs announced production of its UT7R2XLR816 Clock Network Manager, featuring eight independently programmable output banks. Bank programmability includes: frequency, I/O type (LVDS or CMOS), polarity, skew, and voltage. Aeroflex's

first clock product, the UT7R995, supplied four programmable output banks and began production in 2006. Aeroflex's UT7R2XLR816 is a flexible clock network management device, supplying up to 16 clock outputs over eight banks, with independent power supplies for each bank (+2.25V to +3.6V), giving the user greater flexibility in multi-voltage systems. Additionally, outputs can be configured as LVCMOS or standard LVDS pairs. An adjustable phase feature allows the control of phase on each output bank with respect to the reference clock. Applications, such as high-altitude avionics, satellites, x-ray cargo scanners, test and measurement, networking, telecommunications, and mass storage can take advantage of the UT7R2XLR816's low jitter (< 50ps), wide operating range (24MHz to 200MHz), and a total dose tolerance of 100 krads(Si). The UT7R2XLR816 Clock Network Manager is available as QML Q and V for HiRel applications and has been assigned SMD #5962-08243. Prototypes are available along with an evaluation board to support design development and debug. Production parts are priced at $1825.00 for 100 quantity QML Q. For more information, visit Aeroflex online at www.aeroflex.com.

» DATA BUSES AND NETWORKING

MIL-STD-1553 databus interface from National Hybrid combines transceiver and transformer

National Hybrid Inc. in Ronkonkoma, N.Y., and Pulse Engineering in San Diego are introducing the Bus+ (pronounced Bus Plus) MIL-STD-1553 data bus that combines a transceiver and transformer into one package. Designed for avionics and defense applications, the Bus+ is for space-constrained, mission-critical environments like aircraft and unmanned vehicles. By combining National Hybrid's proprietary transceiver ASIC and Pulse's 1553-45 or 1553-71 dual ratio transformer into one databus interface board product, the Bus+ transceiver has a dynamic offset range of -250 millivolts to +250 millivolts, as well as a maximum output noise of 10 millivolts and a minimum output impedance of 3,000 Ohms. The Bus+ operates with a +5 VDD or +3.3 VDD power supply, +/-5 percent. With a 5-volt power supply, the Bus+ dissipates as much as 0.184 watts of power and 35 milliamps of current in standby (no transmission) and less than 1.0 watt with one-channel transmitting at 100 percent duty cycle. The peak pulse current for 5-volt operation is



650 milliamps and 900 milliamps for +3.3-volt operation. The receiver differential input voltage is 15 VPP for the +5-volt version and 12 VPP with a +3.3-volt power supply. The device measures 0.4 by 0.4 by 0.185 inches, and operates in temperatures from -40 to 85 degrees Celsius, or a military operating temperature range from -55 to 125 C. For more information, visit National Hybrid online at www.nationalhybrid.com.

» CONNECTORS

Sabritec releases rugged connector product line

Sabritec in Irvine, Calif., is introducing a high-power rugged connector line for harsh environments. Sabritec's high-power connectors use the Hypertac Hyperboloid contact technology for low contact resistance. These connectors provide higher current ratings with smaller contacts as compared to standard bifurcated contact designs of similar size, saving overall weight and space,

company officials say. Key features include low coupling force; improved low rate of wear and high coupling durability; shock and vibration resistance; insulated contact elements to enable multi-pole use (coaxial); power switching through contact mating sequencing, mating of shorter contact can energize main power for system or safety requirements; and an increased power-handling capability of 25 percent compared to standard contacts, company officials say. Sabritec specializes in the design and manufacture of coax, triax, filtered, and high-speed interconnects (Fibre Channel, Ethernet, FireWire), fiber-optic connectors, contacts, and cable assemblies. For more information, visit www.sabritec.com.

» SIGNAL PROCESSING

Pentek introduces specialized beamforming module for PCs

Pentek Inc. in Upper Saddle River, N.J., introduced two beamformer PCI Express modules for military communications applications. Each is a high-speed software radio board for processing baseband RF or IF signals and uses beamforming functions. The Pentek Models 7753 and 7853 differ in the number of channels and PCIe lanes; eight channels and x16 wide PCI Express interface in the former, four channels and x8 wide PCI Express interface in the latter. Each module houses as many as four or eight 200 MHz, 16-bit A/Ds, each equipped with its own wideband digital down converter (DDC). By daisy-chaining two or more boards through a pair of high-speed connectors mounted on the edge of each module, the beamforming chain can extend beyond the four or eight channels on each board. Xilinx's Aurora protocol provides an x4 point-to-point data path between boards at 1.25 gigabits per second. This connectivity supports large systems with numerous antennas. In addition to the high-speed x4 daisy chain, intermediate or final summation results are also available through the PCI Express interface of each board for monitoring, recording or further analysis. For antennas in an

NEW PRODUCTS

array, signals from a single source arrive at slightly different times, based on the distance between the source and each antenna, Pentek officials say. Beamforming involves compensating the gain and phase of each antenna signal before summation to line up the arrival phase for a particular angle of arrival from the source. In other words, the gain and the phase of each channel can be adjusted so the antenna array is effectively steered electronically. This provides an agile directional sensitivity for the overall antenna array, and enhances signal strength and signal/noise ratio for sources along the specified direction, company officials say. All these essential beamforming functions are resident as factory-installed IP algorithms in the field-programmable gate arrays (FPGAs) of the 7753 and 7853. For more information, visit www.pentek.com.

CORE i7 PRODUCTS

from page 43

Ethernet ports, four SATA300 disk interfaces and dual head graphics, the PP 712/08x embedded computer also offers rear I/O interfaces that are compatible with the PP 512/06x family. The PP 712/08x family is based on the combination of the Intel Core i7 processor and an Intel Platform Controller Hub (PCH), the Mobile Intel QM57 Express chipset. For high performance I/O processing the PP 712/08x family supports two PMC/XMC sites that support operation as fast as 133 MHz PCI-X operation as well as x8 PCI Express XMC interfaces. For more information, visit Concurrent Technologies online at www.gocct.com.

PRODUCT & LITERATURE SHOWCASE

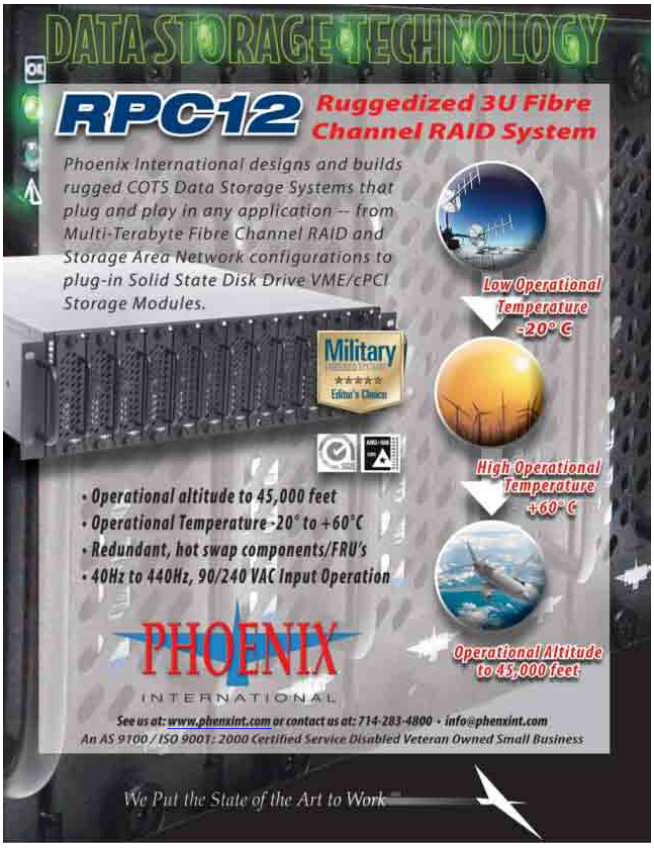
PRODUCT & LITERATURE SHOWCASE

ST-9020 rugged computer system with 20" display, MIL STD shock & vibration qualified

DU-19/U rugged monitor

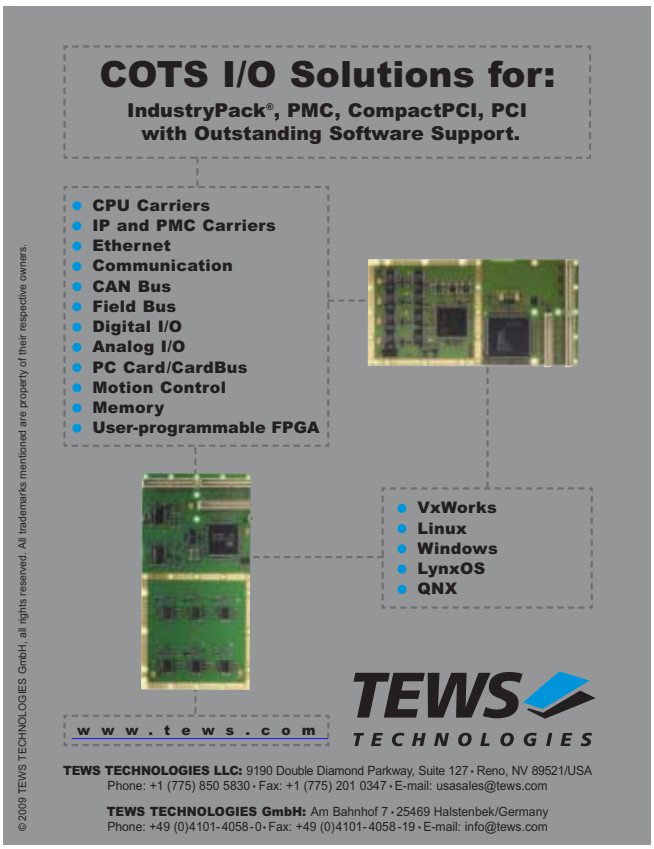
For full line of rugged systems contact:

IBI SYSTEMS, INC.
6842 NW 20TH AVE, FORT LAUDERDALE, FL 33309
PHONE; 954-978-9225, WEB: www.ibi-systems.com



ADVERTISERS INDEX

ADVERTISER	PAGE
AEROFLEX COLORADO SPRINGS	21
AEROFLEX PLAINVIEW	31
AITECH DEFENSE SYSTEMS INC.	23
AP LABS	17
BITTWARE, INC.	19
CRYSTAL GROUP, INC.	29
CURTISS-WRIGHT CONTROLS EMBEDDED COMPUTING	C4
DRS TECHNOLOGIES RSTA	1
ELMA BUSTRONIC	30
ENGINEERING DESIGN TEAM	35
EXTREME ENGINEERING SOLUTIONS	7
FLIR SYSTEMS, INC.	5
IBI SYSTEMS, INC.	47
IN-PHASE TECHNOLOGIES	35
INTERNATIONAL RECTIFIER	3
ISI/NALLATECH	41
KONTRON AMERICA	27
M.S. KENNEDY CORPORATION	13
MERCURY COMPUTER SYSTEMS	2
OMNETICS CONNECTOR CORP.	8
PHOENIX INTERNATIONAL	47
PICO ELECTRONICS, INC.	9, 33
RGB SPECTRUM	46
SYNQOR	20
TEWS TECHNOLOGIES	47
THEMIS COMPUTER	25
VICOR CORPORATION-BRICK BUSINESS UNIT	C2, 15
WHITE ELECTRONIC DESIGNS INC.	11



MILAERO.COM

Military & Aerospace Electronics

Best of the Web

MILAERO BLOG

Ridge and Franks: Donate to Flight 93 memorial

Former U.S. Homeland Security Secretary Tom Ridge and General Tommy Franks, USA (Ret.), honorary co-chairs of the Flight 93 National Memorial Campaign, are urging everyone to honor the heroism of the passengers and crew of United Flight 93. More than 57,000 donors have raised over $17 million for the memorial, the first phase of which costs $58 million cost.

The Flight 93 National Memorial is the only national park unit dedicated to the

events of September 11, 2001. The memorial park sits on 2,231 acres in Somerset County, site of the plane's crash, approximately 80 miles outside Pittsburgh. The memorial will include the final resting places of the heroes, as well as visitor facilities and related infrastructure.

For information on how to contribute to the memorial, visit www.honorflight93.org.

more www.pennwellblogs.com/mae

AVIONICS INTELLIGENCE

Rockwell Collins next-generation avionics complete first flight on Boeing's 747-8 Freighter

Rockwell Collins next-generation avionics aided the first flight of Boeing's 747-8 Freighter. The new airplane features an entire suite of Rockwell Collins avionics displays, autopilot, communication, navigation, surveillance, maintenance, emergency, and data management systems, including Rockwell Collins DU-7001 LCD displays.

"Rockwell Collins collaborated with Boeing to create a powerful airplane equipped for the next-generation airspace, while keeping required pilot training to a minimum by maintaining an interface similar to the 747-400," says Kelly Ortberg, EVP and COO, Commercial Systems for Rockwell Collins.

more www.avionics-intelligence.com

DEFENSE EXECUTIVE

DARPA eyes foliage-penetrating radar signal processing workstation to detect infantry in forests

Radar signal processing experts at the U.S. Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., are asking industry to develop a data-processing workstation to help pinpoint concentrations of foot soldiers moving in thick forests and other dense foliage.

The idea is to process radar signals from a foliage penetrating (FOPEN) radar mounted to manned and unmanned helicopters to filter out radar clutter like animals, windblown foliage, and moving water to estimate the position, size, and direction of travel of infantry concentrations moving in foliage. The program is called Foliage Penetrating Ground Moving Target Indicator Radar Exploitation and Planning (FOPEN-GXP). Its goal is to develop and integrate a set of tools to enhance foliage-penetrating radar data as modules into a FOPEN-GXP system workstation.

more www.milaero.com

COMMAND POST COMMUNITY

Crane sponsors service dog for wounded veteran

Crane Aerospace & Electronics, a Crane Co. segment in Redmond, Wa., has sponsored the teaming of a wounded Operation Iraqi Freedom veteran with a service dog through Canine Companions for Independence. The sponsored veteran, Army Specialist Andrew Pike, 23, and his new companion, Yazmin, finalized their training with a public graduation ceremony in Santa Rosa, Calif..

Photograph by Bob Datto.

Pike served with the 82 Airborne in Baghdad and was wounded when a sniper's bullet paralyzed him from the waist down. Yazmin will assist Pike in his everyday life and provide companionship. The dog responds to nearly 40 commands, and can pull Pike's wheelchair, pick up dropped items out of his reach, and open doors.

more http://community.milaero.com